MX150001B

Wander (MTIE/TDEV) Measurement Application Software

Operation Manual

Third Edition

Read this manual before using the equipment.
Keep this manual with the equipment.

Digital. com Division
Measurement Solutions
ANRITSU CORPORATION

AUG.
2000

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Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Insure that you clearly understand the meanings of the symbols BEFORE using the equipment.
Some or all of the following five symbols may not be used on all Anritsu equipment. In addition, there may be other labels attached to products which are not shown in the diagrams in this manual.

Symbols used in manual

DANGER ⚠ This indicates a very dangerous procedure that could result in death or serious injury if not performed properly.

WARNING ⚠ This indicates a hazardous procedure that could result in death or serious injury if not performed properly.

CAUTION ⚠ This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Insure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.

This indicates warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

MX150001B
Wander (MTIE/TDEV) Measurement Application Software
Operation Manual

15 May 2000 (First Edition)
21 July 2000 (Third Edition)

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For Safety

WARNING ⚠

1. ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.
   Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

2. When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, before supplying power to the equipment, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Repair

WARNING ⚠

3. This equipment cannot be repaired by the user. DO NOT attempt to open the cabinet or to disassemble internal parts. Only Anritsu-trained service personnel or staff from your sales representative with a knowledge of electrical fire and shock hazards should service this equipment.
   There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision parts.

Falling Over

4. This equipment should be used in the correct position. If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.

For Safety

CAUTION ⚠

Storage media

This equipment uses a hard disk drive and a floppy disk drive as storage media for storing data and programs.

If this media is mishandled, important data may be lost. To prevent this chance occurrence, all important data and programs should be backed-up.

Anritsu will not be held responsible for lost data.

Pay careful attention to the following points.

- Do not turn off the power during accessing the disk.
- Do not shock or vibrate this equipment for protecting the disk from damages.
- Do not remove the floppy disk during accessing the disk.
- Keep the specified environmental condition, and do not expose the disk to dust.
- Do not place the disk near any magnetic objects, and do not bend the disk.

Equipment Certificate

Anritsu guarantees that this equipment was inspected at shipment and meets the published specifications.

Anritsu Warranty

- During the warranty period, Anritsu will repair or exchange this software free-of-charge at the company's own discretion if it proves defective when used as described in the operation manual.
- The warranty period is 1 year from the purchase date.
- The warranty period after repair or exchange will remain 1 year from the original purchase date, or 30 days from the date of repair or exchange, depending on whichever is longer.
- This warranty does not cover damage to this software caused by Acts of God, natural disasters, and misuse or mishandling by the customer.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation will not accept liability for equipment faults due to unforeseen and unusual circumstances, nor for faults due to mishandling by the customer.

Anritsu Corporation Contact

If this equipment develops a fault, contact Anritsu Corporation or its representatives at the address in this manual.

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Section 1 Outline

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1.1 Outline of Products

MX150001B Wander (MTIE and TDEV) Measurement Application Software (hereafter called this system) sends and receives Wander measurement data (TIE) using Anritsu MP1570A SONET/SDH/PDH/ATM Analyzer and peripherals. The communication is done by RS232C. This software also draws a graph by calculating MTIE or TDEV based on the data obtained from the communication.

Features

- Easy operation

This system operates on an IBM compatible personal computer that is running Windows 95 or later. Also, since this system adopts LabWindows/CVI for development, high-operability applications are realized.

- Automatic control for MP1570A

This system controls the MP1570A via GPIB or RS232C.

- Saving and reading measuring results

This system saves and reads data of MTIE and TDEV measuring results.

- Printing measuring results

This system can print measuring result data and graphs.

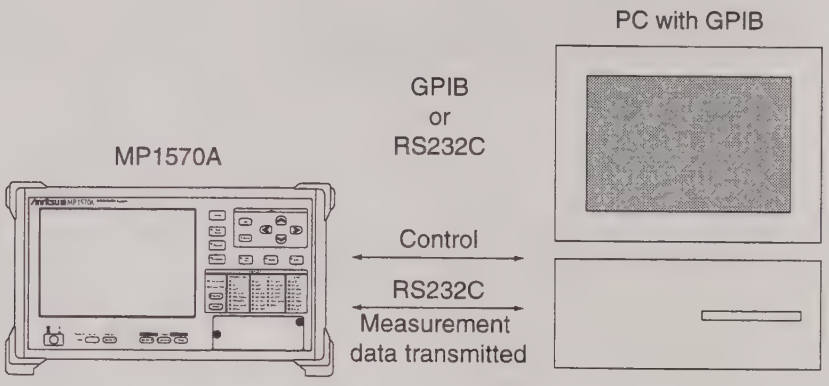
1.2 Configuration of Operation Manual

MX150001B Wander (MTIE and TDEV) Measurement Application Software Operation Manual has the following three sections and appendix.

Section Number	Explanation
Section 1 Outline	Outline of products, configuration of operation manual, system configuration, specifications
Section 2 Preparation	Environment condition at installation location, safety measure, file configuration, preparation, notes on use, how to use applications properly, installation, uninstallation
Section 3 Operation	System activation, system termination, display of measuring condition, display of measurement start time, title input, data read, options, data save, setting of interfaces, setting of measurement parameter, measurement and data read from MP1570A, graph, print
Appendix Definitions of Jitter-wander	Definition of jitter and wander, wander evaluation

1.3 System Configuration

1.3.1 System Configuration



Main unit: MP1570A SONET/SDH/PDH/ATM Analyzer

Units and options: MP1570A has the following three combinations of units in this system:

[1] Main unit + MP0121A + MU150005A (with Option02) + MU150011A* + MU150008A/9A/10A*

[2] Main unit + MP0122A + MU150006A (with Option02) MU150011A* + MU150008A/9A/10A*

[3] Main unit + MP0121A + MP0122A/B + MU150007A (with Option02) + MU150011A* + MU150008A/9A/10A*

* Required for the evaluation of frequency up to 2.5 GHz.

Basic unit:
MP0121A 2/8/34/139/156M unit
MP0122A/B 1.5/45/52M unit
MU150008A 2.5 (1.31) unit
MU150009A 2.5 (1.55) unit
MU150010A 2.5 (1.31/1.55) unit

Jitter unit:
MU150005A 2/8/34/139M 156/622M Jitter unit + Option02 (Wander measurement)
MU150006A 1.5/45/52M 156/622M Jitter unit + Option02 (Wander measurement)
MU150007A 2/8/34/139M 1.5/45/52M 156/622M Jitter unit + Option02 (Wander measurement)
MU150011A 2.5 G Jitter unit

Personal computer:

IBM-PC AT compatible machine
Required operating environment is 200 MHz Pentium CPU or more, numerical processing unit, and 64 MB memory or more. The processing speed differs depending on CPU or numerical processing unit. Therefore, when calculating data for over 12,000 seconds, use in the operating environment a Pentium CPU, 400 MHz or more, and a coprocessor.

Required hard disk space differs depending on the measurement time. For measurement, disk space of 480 bytes/1 second is required (approximately 57.6 Mbytes are required when measuring for 120,000 seconds).

When saving text data simultaneously, disk space of 260 bytes/1 second is required other than the above (approximately 31.2 Mbytes are required when measuring for 120,000 seconds).

GPIB interface board:

AT-GPIB/TNT manufactured by National Instruments Ltd.

Software: MS-DOS Ver. 5.0 or later (English or Japanese version), MS-WINDOWS 95 or later (English or Japanese version)

1.3.2 Accessories Supplied

Floppy disk for MTIE/TDEV	1 set (2 disks)
Operation manual	One copy

1.4 Specifications

1.4.1 Wander Signal Input

• Bit rate (when Jitter/Wander measurement = data is selected)

1.544 Mbit/s ±50 ppm, 44.736 Mbit/s ±50 ppm, 51.84 Mbit/s ±50 ppm, 2.048 Mbit/s ±50 ppm, 8.448 Mbit/s ±50 ppm, 34.368 Mbit/s ±50 ppm, 139.264 Mbit/s ±50 ppm, 155.52 Mbit/s ±50 ppm, 622.08 Mbit/s ±50 ppm, 2488.32 Mbit/s ±50 ppm

• Frequency (when Jitter/Wander measurement=clock is selected)

1.544 MHz ±50 ppm, 44.736 MHz ±50 ppm, 51.84 MHz ±50 ppm, 2.048 MHz ±50 ppm, 8.448 MHz ±50 ppm, 34.368 MHz ±50 ppm, 139.264 MHz ±50 ppm, 155.52 MHz ±50 ppm, 622.08 MHz ±50 ppm, 2488.32 MHz ±50 ppm

1.4.2 Wander Reference Signal Input

(1) Frequency

Bit rate/frequency: 2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK)
1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
64 k + 8 kHz ±50 ppm or 5 MHz ±50 ppm or 10 MHz ±50 ppm

(2) Interface/level

Unbalance:	1.544 MHz, 2.048 MHz (CLOCK) ;	1.125 Vo-p ±34 % G.703
	2.048 Mbit/s (HDB3);	2.37 Vo-p ±10 % G.703
	5 MHz, 10 MHz;	0 to +10 dBm
Balance:	1.544 Mbit/s;	3.0 Vo-p ±24 % ANSI T1.102-1987
	2.048 Mbit/s;	3.0 Vo-p ±24 % G.703
	64 k + 8 kHz;	3.0 Vo-p ±24 %

(3) Load/connector

Unbalance:	75 Ω/BNC (1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz)
Balance:	100 Ω/Weco310 Compatible (1.544 Mbit/s)
	120 Ω/3-Pole CF (64 k + 8 kHz, 2.048 Mbit/s)

1.4.3 Manual Wander Measurement

(1) Evaluation mode

P-P, +P, -P, TIE

(2) Bandwidth

<10 Hz

(3) Sampling period

25 ms, 1 s, 10 s, 200 s

(4) Measurement range

P-P	0.0 to 2.0×10^{10} ns
+P, -P	0.0 to 1.0×10^{10} ns
TIE	0.0 to $\pm 1.0 \times 10^{10}$ ns
MTIE	0.0 to 1.0×10^{8} ns
TDEV	0.0 to 1.0×10^{8} ns

(5) Measurement time

1 sec to 1×10^{8} sec

(6) Resolution

0.1 ns

(7) Accuracy

• TIE

±0.5 % ±Z0 (τ)

Z0 (τ) (ns)	Observation Time τ (s)
2.5 + 0.0275 τ	0.05≤ τ ≤1000
29 + 0.001 τ	τ >1000

• MTIE

±1.0 % ±Z3 (τ)

Z0 + Z1 = Z3

Z1: MTIE error of MTIE algorithm

Z1 (τ) (ns)	Observation Time τ (s)
3 + 0.033 τ	0.05≤ τ ≤1000
35 + 0.0012 τ	τ >1000

• TDEV

±1.0 % ±Z4 (τ)

Z0 + Z2 = Z4

Z2: TDEV error of TDEV algorithm

Z2 (τ) (ns)	Integration Time τ (s)
0.36	0.05≤ τ ≤100
0.0036 τ	100< τ ≤1000
3.6	1000< τ ≤10,000

(8) Filter selection

DC to 0.01 Hz

DC to 10 Hz

0.01 to 10 Hz

1.4.4 Automatic Wander Measurement

(1) Test menu

• Wander

TIE: Observation Time: 10 to 1×10^8 sec

MTIE: Observation Time: same as TIE observation time

TDEV: Integration Time: 1/12 sec. of TIE observation time

• Wander tolerance (TDEV): Observation Time: 12 to 12,000 sec

(Integration Time: 1 to 1,000 sec)

• Wander transfer (TDEV): Observation Time: 12 to 12,000 sec

(Integration Time: 1 to 1,000 sec)

(2) Sampling rate

40 Hz, 1 Hz, 0.1 Hz, 5 mHz

(3) Calculation timing of measurement data

*For calculation timing of measurement data, either of real time or post-measurement calculation is applied depending on the sampling time and measurement time.

Sampling Rate \ Measurement Time	τ ≤ 1,000 sec	1,000 sec < τ ≤ 12,000 sec	12,000 sec < τ ≤ 120,000 sec	120,000 sec < τ ≤ 1,000,000 sec	1,000,000 sec < τ
40 Hz	Real time calculation	Real time calculation	Post-measurement calculation	Not selectable	Not selectable
1 Hz	Real time calculation	Real time calculation	Real time calculation	Not selectable	Not selectable
0.1 Hz	Real time calculation	Real time calculation	Real time calculation	Real time calculation	Not selectable
0.005 Hz	Real time calculation	Real time calculation	Real time calculation	Real time calculation	Real time calculation

(3) Calculation timing of measurement data

*For calculation timing of measurement data, either of real time or post-measurement calculation is applied depending on the sampling time and measurement time.

Sampling Rate \ Measurement Time	τ ≤ 1,000 sec	1,000 sec < τ ≤ 12,000 sec	12,000 sec < τ ≤ 120,000 sec	120,000 sec < τ ≤ 1,000,000 sec	1,000,000 sec < τ
40 Hz	Real time calculation	Real time calculation	Post-measurement calculation	Not selectable	Not selectable
1 Hz	Real time calculation	Real time calculation	Real time calculation	Not selectable	Not selectable
0.1 Hz	Real time calculation	Real time calculation	Real time calculation	Real time calculation	Not selectable
0.005 Hz	Real time calculation	Real time calculation	Real time calculation	Real time calculation	Real time calculation

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2.1 Environment Condition of Installation Location

The operating temperature and humidity required for this system depend on the peripheral equipment to be controlled. Also, the storage temperature depends on the peripheral equipment. For details, refer to operation manual of each measuring instrument and the peripheral equipment.

Avoid use and storage under the following conditions:

- Severe vibration
- Dust
- Direct sunlight
- Oily gas
- Condensation

CAUTION ⚠

If the attached floppy disks are not correctly used and have a failure, the data may be damaged.
Therefore, make a back-up copy of the saved data.
Pay full attention to storage environment of floppy disks.

2.2 Safety Measure

For safety, carefully read the operation manual of the peripheral before using this system.

2.3 Proper Use of Applications

This system is prepared for the operating environment under which Windows 95 runs. However, if multiple applications are used together with this system, memory shortage may occur.

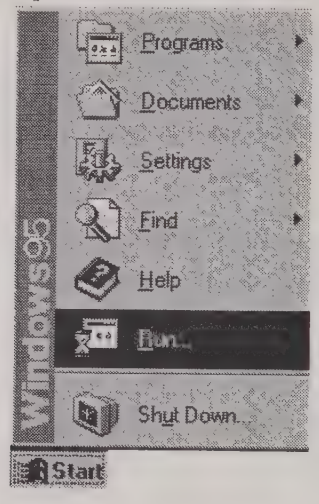
Therefore, to execute this system, terminate other applications. If multiple operations are executed simultaneously, the operation may not be guaranteed.

2.4 Installation

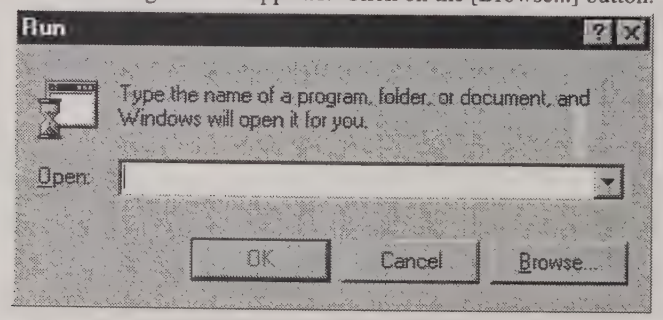
Installation using Windows 95

(1) Insert the installation disk No.1 for this system in the floppy disk drive.

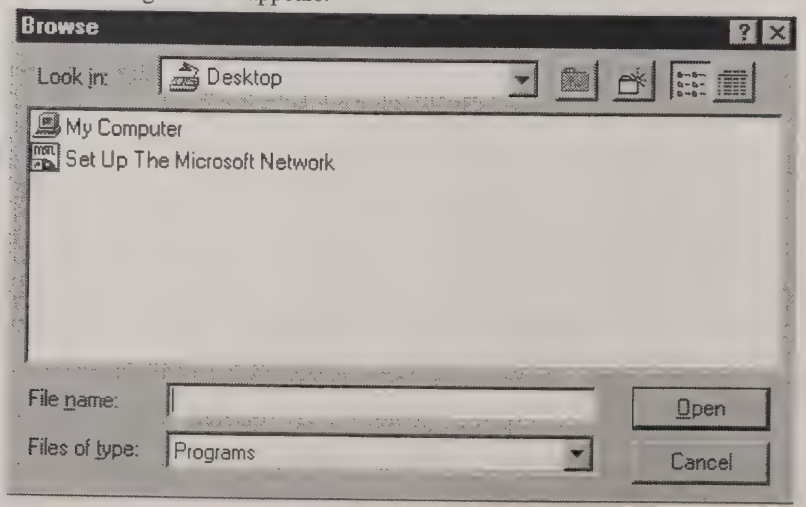
(2) Open the Start Menu and select [Run].



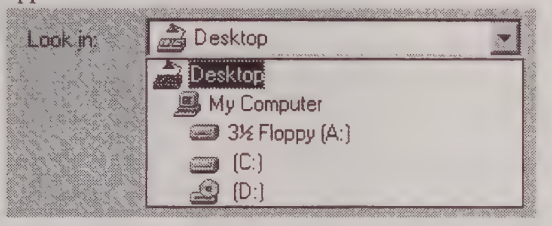
(3) The following window appears. Click on the [Browse...] button.



(4) The following window appears.

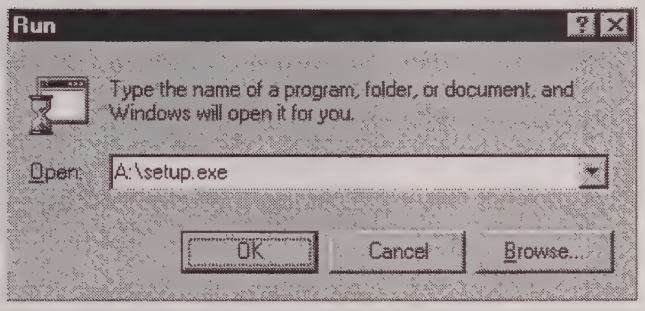


(5) When the bar located on the right of [Look in] is clicked, the following menu appears. Then select the drive that the installation disk is inserted.

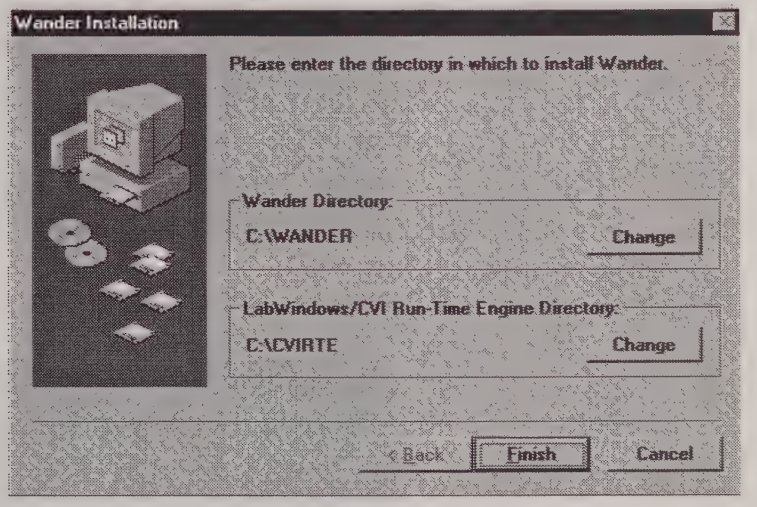


(6) Select [setup.exe] among the items listed on the center, then click on the [Open] button.

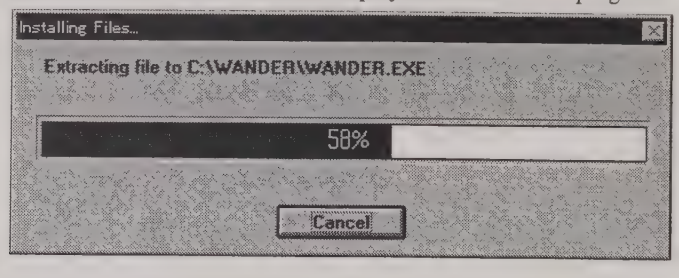
(7) After making sure that [x:\setup.exe] is shown in the center bar of the window as shown, click on the [OK] button. (x indicates the drive that the installation disk is inserted.)



(8) The following window appears. Click on the [Finish] button.

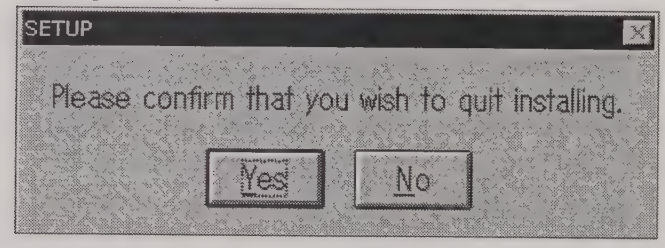


(9) During installation, a window is displayed to indicate the progress.

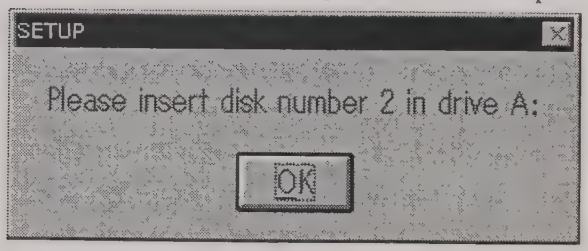


To cancel installation, click on the [Cancel] button.

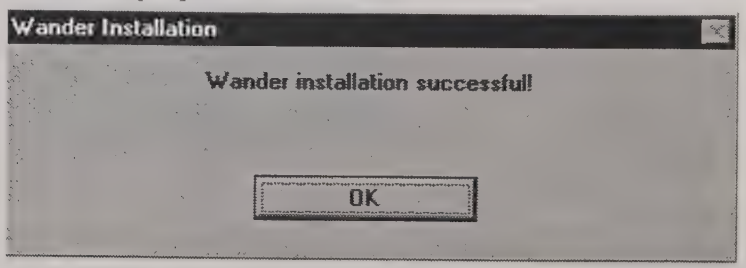
After clicking the [Cancel] button, a confirmation message for the cancellation is displayed. When the [Yes] button is clicked, installation is terminated. The installed data is not deleted and remains in the disk to which installation is done. Clicking on the [No] button resumes installation.



(10) This system has two installation disks. During installation, a message prompting disk replacement will appear. When the message appears, replace the No. 1 disk with No. 2 and click on the [OK] button. Installation procedure continues.



(11) When installation has completed, the following confirmation window appears. Click on the [OK] button.



2.5 File Configuration

The following describes the files to be installed in the hard disk drive when this system is installed.
(* indicates the drive that the file is installed.)

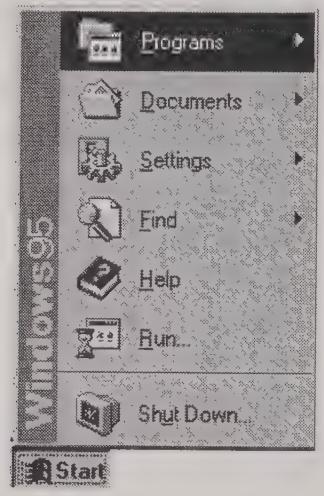
* \MX150001B\Wander.exe (Main unit of the MX150001B Wander (MTIE, TDEV) Measurement Application Software)
* \MX150001B\Dibapi.dll
* \MX150001B\Prt201.dl
* \MX150001B\Editmask.uir
* \MX150001B\Fscale.uir
* \MX150001B\Intface.uir
* \MX150001B\Main.uir
* \MX150001B\Measpara.uir
* \MX150001B\Mtieg.uir
* \MX150001B\Option.uir
* \MX150001B\Passage.uir
* \MX150001B\Prtscreen.uir
* \MX150001B\Tdevg.uir
* \MX150001B\Tieg.uir
* \MX150001B\Uninst.exe
* \MX150001B\Uninst.lrm
* \MX150001B\Wander.ini

The above files must be saved in the same directory.

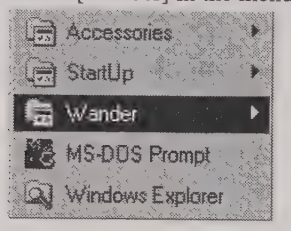
2.6 Uninstallation

Uninstallation using Windows 95

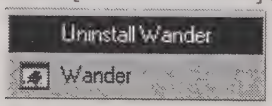
(1) Open the Start Menu and select [Programs].



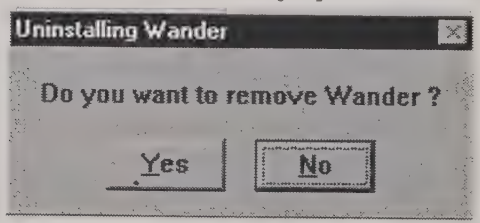
(2) Select [Wander] in the menu shown.



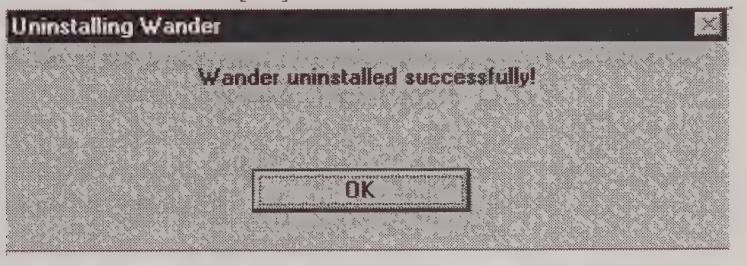
(3) Select [Uninstall Wander] from the menu.



(4) A confirmation window for uninstallation appears. To uninstall this system, click on the [Yes] button. Uninstallation procedure starts. To cancel the uninstallation, click on the [No] button. Uninstallation procedure terminates.



(5) When uninstallation has completed, the following window appears for confirmation. Then click on the [OK] button.



2.7 Preparation

Use an appropriate cable to connect the personal computer and the MP1570A to be used for measurement control from the personal computer at the GPIB or RS232C connector located on the rear side.

For Wander measurement data transmission, connect the personal computer to the RS232C connector on the MU15005/6/7A jitter unit, using a cable.

2.8 Notes on Use

When installation procedure is completed, this system operates under the operating conditions guaranteed in subsection 2.1. Select "Small Fonts" in the Windows Display property to use this system.

When the MP1570A is remotely controlled, this system may not operate if the interface of the MP1570A is incorrectly set or files required for operating applications do not exist.

The following describes the measures to be taken when a failure occurs after installation.

(1) Application software cannot be activated.
Required application software may not exist.
For required related files, refer to subsection 2.5, "File Configuration." Check that all the required files exist under the specified directory.

(2) Memory Full message is displayed.
When this message appears during operation or at activation, it indicates that available memory is insufficient.

In such case, perform the following procedure:
- Adding extended memory

Add SIMM or DIMM to increase memory.
- Increasing resident swap files in the Windows

Make the Windows swap files resident, then increase the memory capacity.

(3) Controlling the MP1570A by using GPIB is not correctly done.
Check that the GPIB cable is connected correctly between the MP1570A and the personal computer. Also, check that the GPIB address set on the Interface Setup screen of this system is the same as the address set on the Setup screen of the MP1570A.

Note:

The setting regarding RS232C on the MU15005/6/7A jitter unit for Wander measurement data transmission can be set on the Interface Setup screen of this system. It cannot be changed at the MP1570A side.

(4) Controlling the MP1570A by using the RS232C is not correctly done.
Check that the RS232C cable is connected correctly between the MP1570A and the personal computer. Also, make sure that the items of RS232C on the Setup screen of the MP1570A is set to Control.

Note:

The setting regarding RS232C interface on the MU15005/6/7A jitter unit for Wander measurement data transmission can be set on the Interface Setup screen of this system. It cannot be changed at the MP1570A side.

(5) Printer does not operate properly.
Printer setting for the MX150001B Wander (MTIE, TDEV) Measurement Application Software is done by using the printer driver under the Windows environment. If the printer used does not properly operate, check another application for printing.
If normal printing is gained under the Windows environment, a correct printout is expected. If printing cannot be done, check the setting of the printer driver used.
For the printer driver, use the latest version produced by the software manufacturer.

(6) RS232C error message is displayed.
An error message "Error on jitter unit. No data stream at RS232C" appears.
When incorrect data is sent from the measurement instrument, data may not be successfully received. Perform manual measurement to check that the MP1570A main frame is operating correctly.
When attempting to save the TIE raw data to an FD, data may not be properly received because write time takes too long. Specify another media to save the TIE raw data to other than an FD.
If multiple application software other than the MX150001B is running, processing may not be completed within the receiving interval of the raw data. Terminate other application software, and retry the measurement.

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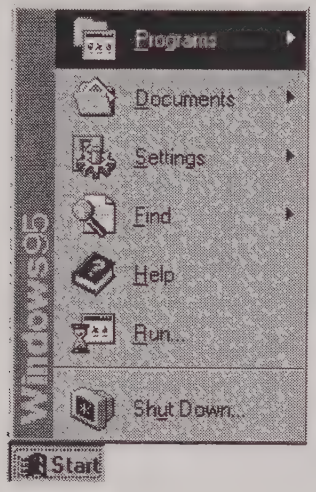
3.1 System Activation

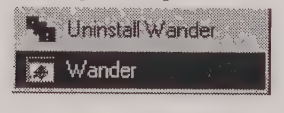
System activation using Windows 95

(1) Open the Start Menu and select [Programs].

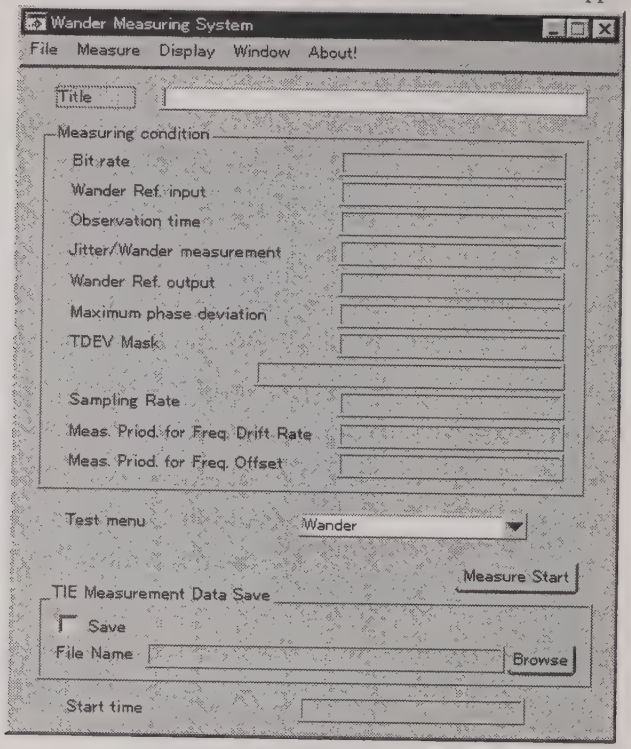


(2) Select [Wander] from the menu displayed.

(3) Select [Wander] from the menu displayed.

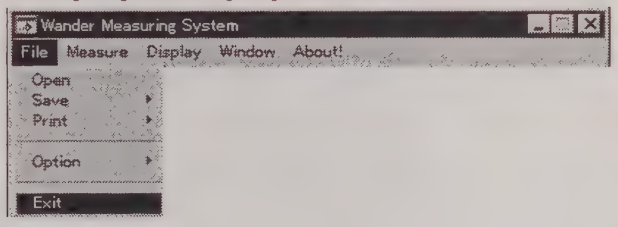


(4) System is automatically activated and the main window appears.

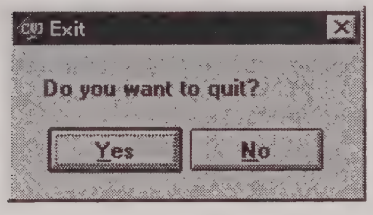


3.2 System Termination

(1) Select [Exit] from the [File] menu on the main window.

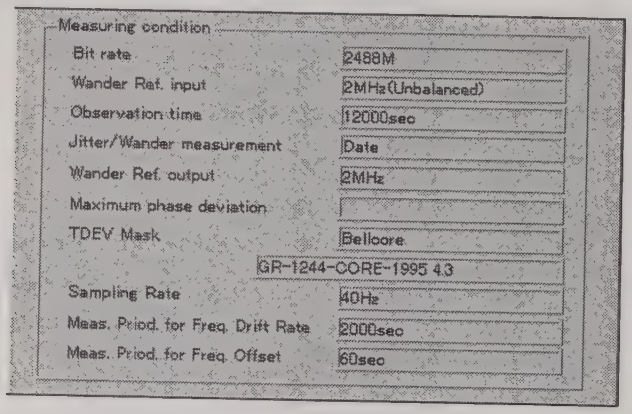


(2) A confirmation dialog box for exit is displayed. To terminate the system, click on the [Yes] button. The system is terminated. Click on the [No] button not to terminate the system. Then the main window appears.



3.3 Display of Measuring Condition

Measuring condition is displayed in the [Measuring condition] pane of the main window.



Each item is described below:

3.3.1 Bit Rate

Indicates Bit rate of measured signals. For details, refer to [Bit rate] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.2 Wander Ref. Input

Indicates Ref. signals for Wander measurement. For details, refer to [Wander Ref. input] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.3 Observation Time

Indicates Wander measurement time. For details, refer to [Observation time] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.4 Jitter/Wander Measurement

Indicates the type (data or clock) of measured signals. For details, refer to [Jitter/Wander measurement] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.5 Wander Ref. Output

Indicates the Wander reference signal output. For details, refer to [Wander Ref. Output] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.6 TDEV Mask

Indicates the TDEV generation Mask pattern of the Wander reference signal output.
This item is effective only when "Wander", "Wander tolerance (TDEV)", and "Wander transfer" are selected in the Test menu.
For details, refer to [TDEV Mask] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.3.7 Measurement Type

Indicates the measurement type (Cal or Meas) of the Wander Transfer measurement.
This item is effective only when "Wander Transfer (TDEV)" is selected in the Test menu.

3.3.8 Sampling Rate

Indicates the sampling frequency of the Wander TIE measurement.

3.3.9 Meas. Period for Freq. Drift Rate/Freq. Offset

Indicates the measurement period to find frequency drift rate and frequency offset.
This item is effective only when "Wander" is selected in the Test menu.
For details, refer to [Meas. Period for Freq. Drift Rate/Freq. Offset] in subsection 3.12.1 "Detailed setting of measurement parameter."

3.4 Setting Test Menu

Test menu can be selected.

Each Test menu item is described below:

3.4.1 Wander

TIE (Time Interval Error), MTIE (Maximum Time Interval Error), and TDEV (Time DEViation) between the measured signal and the standard signal are measured.

When "Wander" is selected in the Test menu, the following items are effective in the Measuring Condition.

- Bit rate
- Wander Ref. Input
- Observation time: Settable range varies depending on the Sampling Rate. For details, refer to [Calculation timing of measurement data] in subsection 1.4.4, "Automatic Wander measurement."
- Jitter/Wander measurement
- TDEV Mask
- Sampling Rate
- Meas.Priod for Freq. Drift Rate:
  Settable when observation time ≥ 1,000 sec. However, under the condition of observation time ≥ Meas. Period for Freq. Drift Rate, and the input range allowed from 1,000 to 5,000 sec. (default value at 2,000 sec.)
- Meas.Priod for Freq.Offset:
  Settable when observation time ≥ 30 sec. However, under the condition of observation time ≥ Meas. Period for Freq. Drift Rate, and the input range allowed from 30 to 120 sec. (default value at 60 sec.)

3.4.2 Wander Tolerance (TDEV)

The Wander reference signal of the MP1507A is generated at the pattern set by the TDEV Mask, whether Error Alrame is generated is confirmed and the TDEV is measured.

When "Wander tolerance (TDEV)" is selected in the Test menu, the following items are effective in the Measuring Condition.

- Bit rate
- Wander Ref. Input
- Observation time: Settable range varies depending on the Sampling Rate. For details, refer to [Calculation timing of measurement data] in subsection 1.4.4, "Automatic Wander measurement."
- Jitter/Wander measurement
- Wander Ref. Output
- TDEV Mask
- Sampling Rate: 320 Hz cannot be selected. For details, refer to [Sampling rate] in subsection 1.4.4, "Automatic Wander measurement."

3.4.3 Wander Transfer (TDEV)

The Wander standard signal of the MP1570A is generated at the pattern* set by the TDEV Mask, and the TDEV is measured.

* TDEV Mask generation has some errors compared to the set patterns, therefore, calibration is required before measurement.
Two methods are available for calibration: one is returning the measuring instrument to measure the error. This method requires measurement twice, calibration and measurement. The other is using the value gained by simulation to apply calibration. This system provides a function that indicates the simulated value (unlimited measuring time) of TDEV value actually generated for the value set by the TDEV Mask pattern. Using this simulated value for a calibration value allows evaluation by one-time measurement. However, since this method does not consider errors at the Wander measurement instrument and the simulated value is calculated by assuming observation time = ∞, a complete result cannot be expected. Use this method when comparing changes for tentative evaluation, etc.

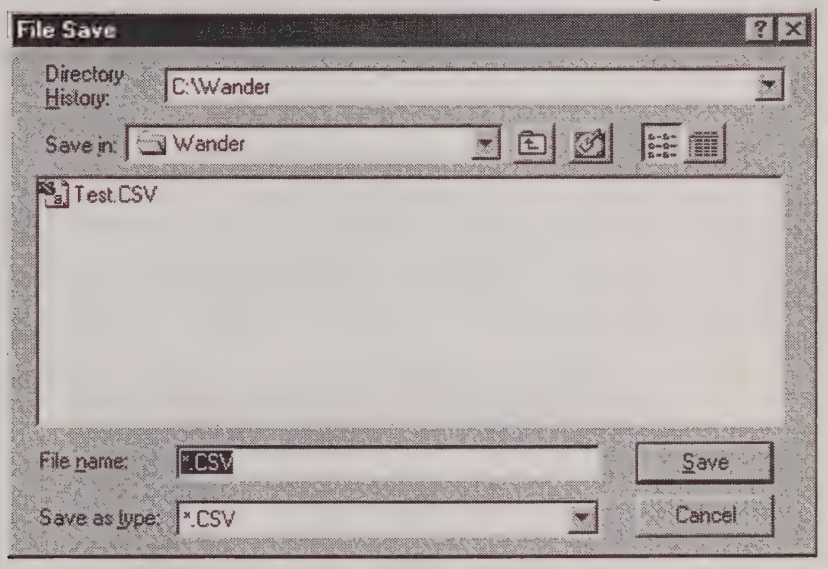
When "Wander transfer (TDEV)" is selected in the Test menu, the following items are effective in the Measuring Condition.

- Bit rate
- Wander Ref. Input
- Observation time: Settable range varies depending on the Sampling Rate. For details, refer to [Sampling rate] in subsection 1.4.4, "Automatic Wander measurement."
- Jitter/Wander measurement
- Wander Ref. Output
- TDEV Mask
- Measurement Type:
  Select one of the following:
  1. To calibrate the error of the measurement instrument (Tx + Rx).
  2. To calibrate the error of the measurement instrument (Tx) by simulation.
  3. The corrected result from the errors of the measurement instrument is obtained.
- Sampling Rate: 320 Hz cannot be selected. For details, refer to [Sampling rate] in subsection 1.4.4, "Automatic Wander measurement."

3.5 Saving TIE Measured Data

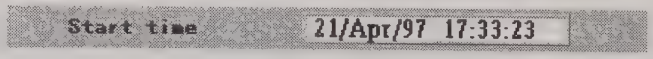
This system allows storing the TIE data in the set file while performing Wander measurement.

Specify a file to which the TIE raw data is to be saved in the [Browse] window. Check the box located in the left of [Save] to save the TIE data file during measurement.



3.6 Display of Measurement Start Time

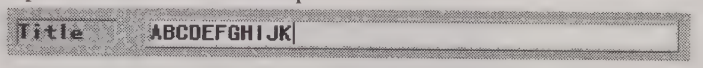
Date and time when measurement started are displayed in [Start time] of the main window.



3.7 Title Input

Titles can be input in [Title] of the main window.

Up to 40 characters can be input.



3.8 Data Read

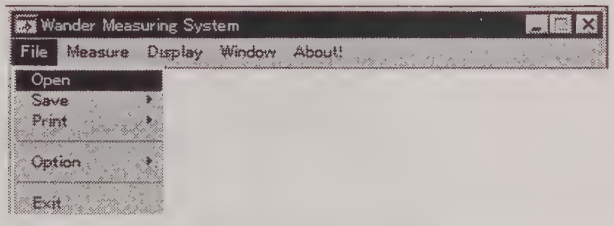
TIE measurement data, TIE graph data, MTIE graph data, TDEV graph data, Wander tolerance (TDEV) graph data, and Wander transfer (TDEV) graph data can be read from a floppy disk or hard disk.

Regarding the TIE measurement data, calculating TIE graph data, MTIE graph data, and TDEV graph data is done after data read.
Extensions of data files are as follows:

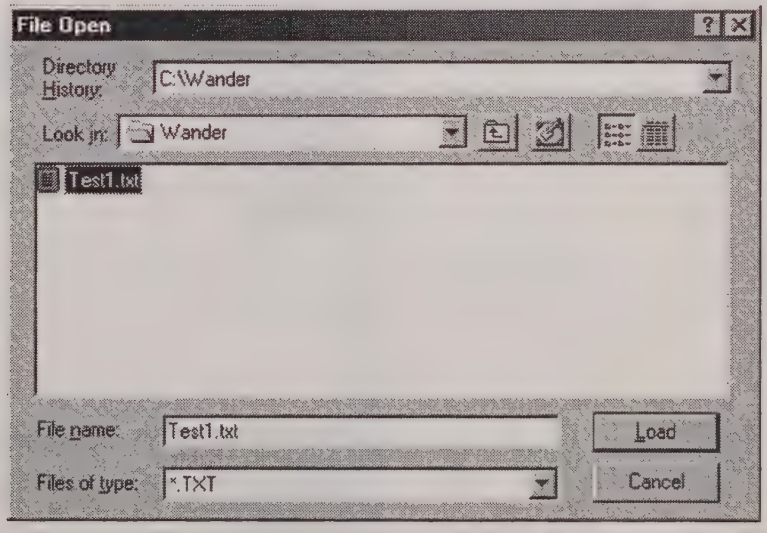
Data Type	Extension
TIE measurement data	CSV
TIE graph data	TXT
MTIE graph data	TXT
TDEV graph data	TXT
Wander tolerance (TDEV) graph data	TXT
Wander transfer (TDEV) graph data	TXT

Read procedure is explained below:

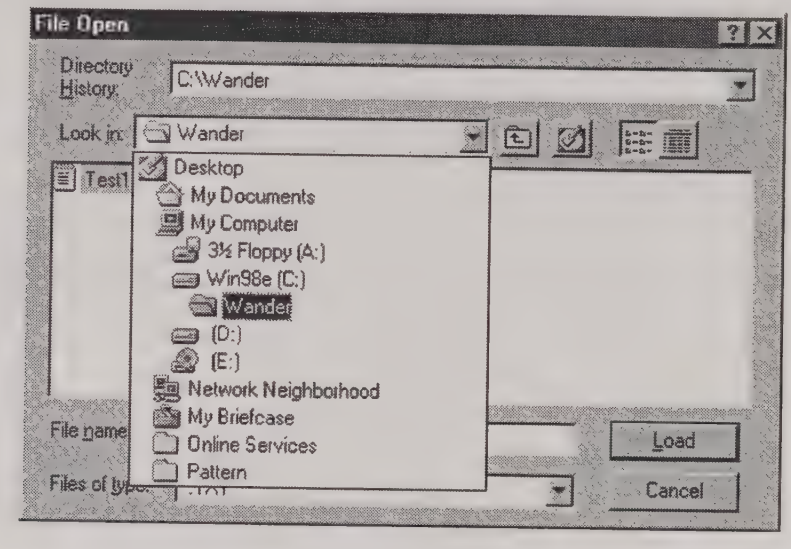
(1) Select [Open] from the [File] menu on the main window.



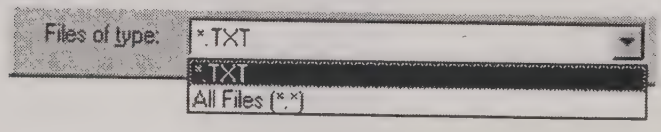
(2) Read window is displayed.



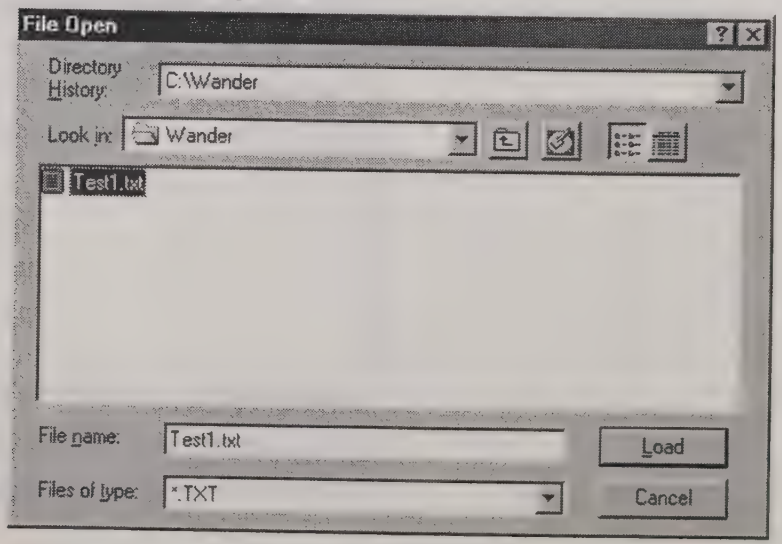
(3) Specify the directory. The contents of the selected directory are displayed in the list located in the middle of the read window. Select the directory containing the data. Double-click on the directory name to determine the directory. The selected directory is displayed in the bar above the list.



(4) Specify the data type. By clicking on the bar on the right of [List Files of Type], which is located at the bottom of the read window, the following menu appears. Select [*.TXT] to read graph data. Selecting [All Files (*.*)] will display all files.

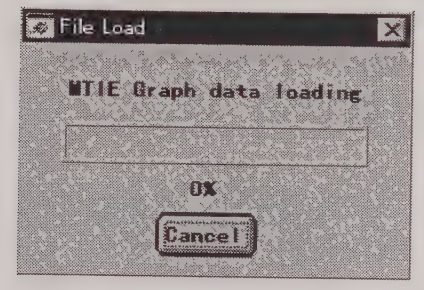


(5) Specify the data file to be read. The files currently saved are displayed in the list located in the middle of the read window. Select a file to be read. The selected list is displayed in the pane below the list.



(6) When the file has been decided, click on the [Load] button in the read window to read. Reading is started. Not to read, click on the [Cancel] button in the read window. All the input information is cancelled and the main window appears.

(7) A window indicating reading status is displayed while reading. To cancel reading, click on the [Cancel] button. Reading is cancelled and the data read up to that time is deleted.



3.9 Setting of MTIE Calculation Mode

When a TIE measurement data is read, calculation of a graph data starts when reading has completed. Calculation of an MTIE graph data can require longer time depending on the amount of data. Therefore, the following two calculation modes are prepared:

(a) Ordinary calculation mode

Calculates using all data based on formula (3). Calculation speed is slow, however.

$$MTIE(\tau) \cong \max_{1 \le k \le N-n} \left(\max_{k \le i \le k+n} - \min_{k \le i \le k+n} \right) \quad \text{.....Formula (3)}$$

(b) High-speed calculation mode

Calculates based on Formula (4). In this mode, all data is not used for calculation. Therefore, error of calculated values may occur.

$$MTIE(\tau) \cong \max_{1 \le k \le n+12} \left(\max_{k \le i \le k+n} - \min_{k \le i \le k+n} \right) \quad \text{.....Formula (4)}$$

N: Number of total samples

τ: Observation time ($\tau = n \bullet \tau_0$)

τ_0: Sampling period

n: Number of samples

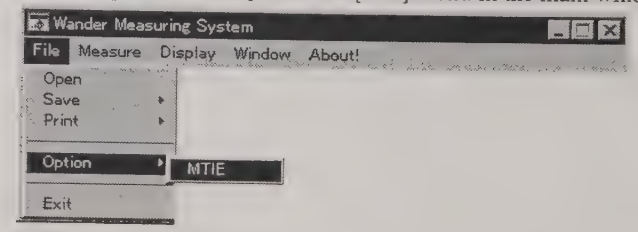
T: Measurement period ($T = N \bullet \tau_0$)

k: Natural number (k = 1, 2...)

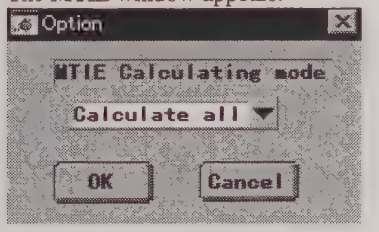
Typical calculation time under the Windows 95 operating environment (e.g., 200 MHz CPU Pentium, 64 Mbyte memory) is 113 minutes and 32 seconds in ordinary calculation mode, and 4 seconds in high-speed calculation mode, respectively for processing 96,000 TIE data.

Setting procedure is as follows:

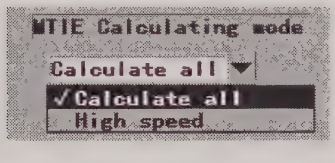
(1) Select [Option]-[MTIE] from the [File] menu in the main window.



(2) The MTIE window appears.



(3) Set the MTIE calculation mode. When the bar below [MTIE Calculation mode] is clicked, a list of the selectable modes is displayed. Then select [Calculate all] for the ordinary calculation mode, or [High speed] for the high-speed calculation mode.



(4) When having completed setting, click on the [OK] button in the option window to adopt all. When the setting has been reflected to the system, the main window appears. To cancel the setting, click on the [Cancel] button in the option window. All the input information is cancelled and the main window appears.

3.10 Data Save

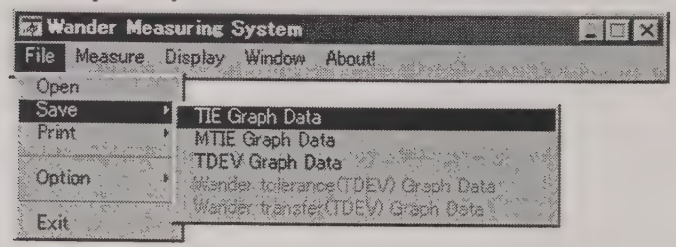
TIE graph data, MTIE graph data, TDEV graph data, Wander tolerance (TDEV) graph data, and Wander transfer (TDEV) graph data can be saved in a floppy disk or hard disk.

Extensions of data files are as follows:

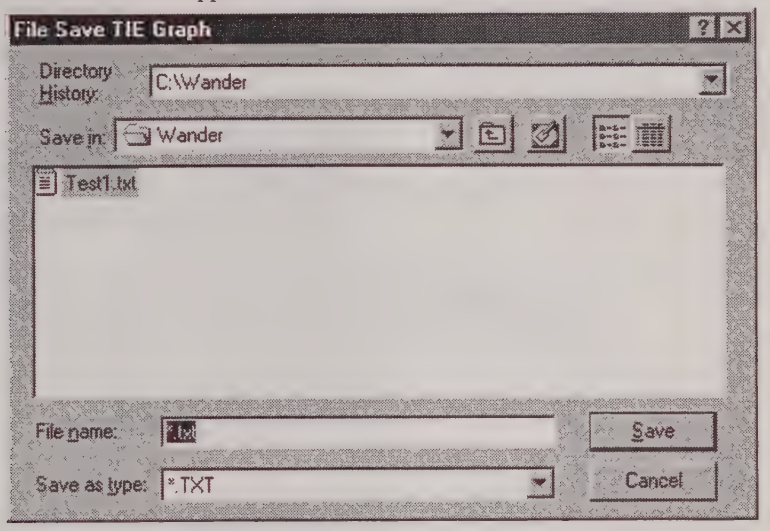
Data Type	Extension
TIE graph data	TXT
MTIE graph data	TXT
TDEV graph data	TXT
Wander tolerance (TDEV) graph data	TXT
Wander transfer (TDEV) graph data	TXT

Save procedure is as follows:

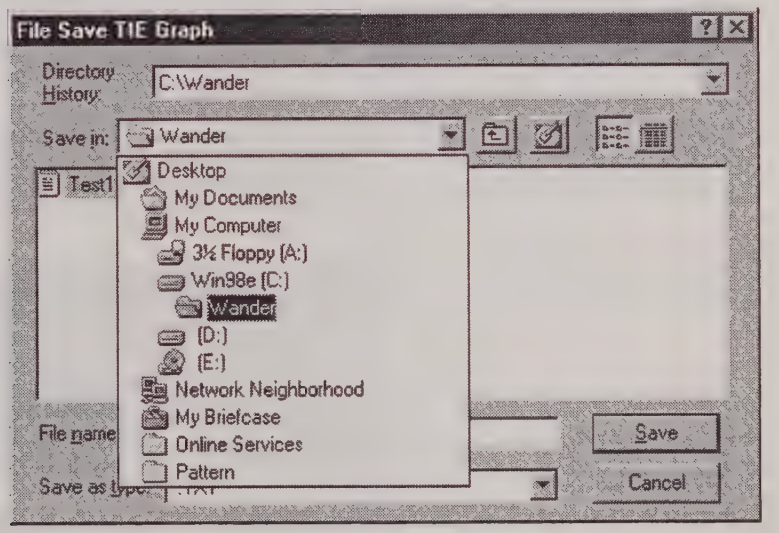
(1) Select [Save] from the [File] menu in the main window. The following menu appears. Select the desired one: [TIE Graph Data], [MTIE Graph Data], [TDEV Graph Data], [Wander tolerance (TDEV) Graph Data], or [Wander transfer (TDEV) Graph Data] to save a TIE graph data, MTIE graph data, TDEV graph data, Transient graph data, Holdover Opt.01 graph data, Holdover Opt.02 graph data, Wander tolerance (TDEV) graph data, or Wander transfer (TDEV) graph data, respectively.



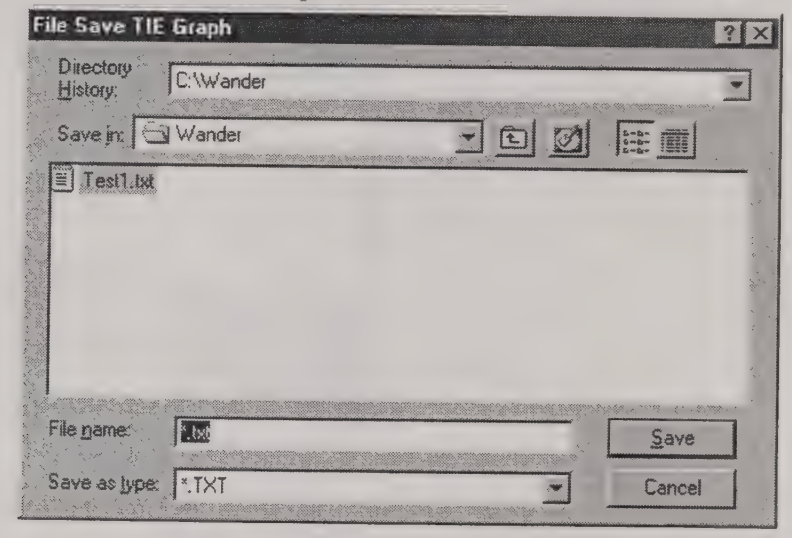
(2) The Save window appears.



(3) Specify the directory. The contents of the selected directory are displayed in the list located in the middle of the save window. Double-click on the directory name to determine the directory. The selected directory is displayed in the bar below the list.

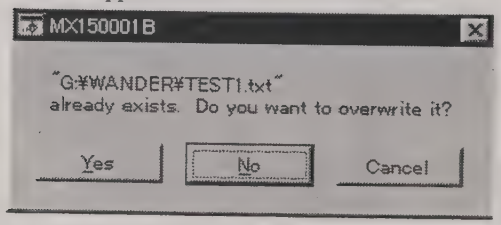


(4) Specify the file to save the data. The list of the files currently saved is shown in the list in the middle of the save window. To save in the existing file, select the file. The selected file is displayed in the pane below the list. To save in a new file, enter a file name in the pane below the list.



(5) When the file has been determined, click on the [Save] button in the save window to save. Save process starts. Not to save, click on the [Cancel] button in the save window. All the input information is cancelled and the main window appears.

(6) If an existing file is to be overwritten, a confirmation window appears. To accept overwriting, click on [Yes]. Overwriting starts. To cancel overwriting, click on [No]. The Save window appears. To cancel saving, click on [Cancel]. The main window appears.

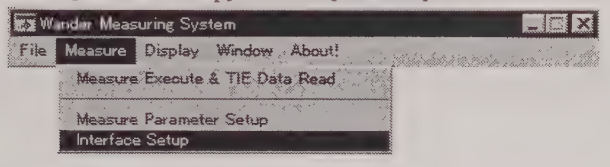


(7) When saving has been completed, the main window appears.

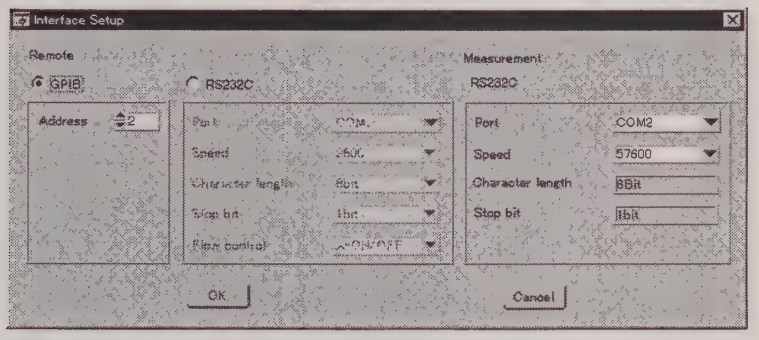
3.11 Setting of Interfaces

In the following, interface to control the MP1570A and to transfer the Wander measurement data is set. Those set in the following will be retained after the system is terminated. Two types of interfaces, GPIB and RS232C, are provided to control the MP1570A. The interface to transfer the Wander measurement data is RS232C.
The following describes the procedures to set each interface.

(1) Select [Interface Setup] from the [Measure] menu in the main window.



(2) The Interface Setup window appears. Two types of interfaces (Remote), GPIB and RS232C, are provided to control the MP1570A. The interface (Measurement) to transfer the Wander measurement data is RS232C.



(3) Select an interface used to control the MP1570A. If an interface is already selected, remain it as it is. Click on [GPIB] or [RS232C] to use GPIB or RS232C, respectively.

(4) Set the details of an interface to be used. The setting varies depending on interface types. For GPIB, refer to 3.11.1 [Detailed setting of GPIB interface for Remote]. For RS232C, refer to 3.11.2 [Detailed setting of RS232C interface for Remote]. For RS232C to transfer the Wander measurement data, refer to 3.11.3 [Detailed setting of RS232C interface for Measurement].

(5) Having completed setting, click on the [OK] button in the Interface Setup window to apply the setting. When the system has reflected the setting, the main window appears. To cancel setting, click on the [Cancel] button in the Interface Setup window. All the input information is deleted and the main window appears.

3.11.1 Detailed Setting of GPIB Interface for Remote

The following item can be set for the GPIB interface for Remote.

(1) Address

The GPIB address can be set in the range from 0 to 30.

Select the value, by clicking on either up or low arrow located on the left of the pane indicating the setting.

3.11.2 Detailed Setting of RS232C Interface for Remote

The following items can be set for the RS232C interface for Remote.

(1) Port

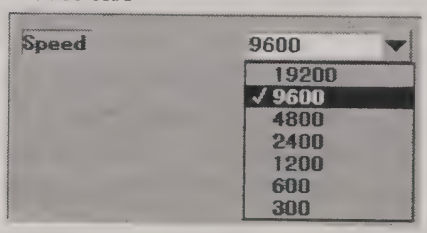
Set the port to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

- COM1
- COM2
- COM3
- COM4

(2) Speed

Set the baud rate to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

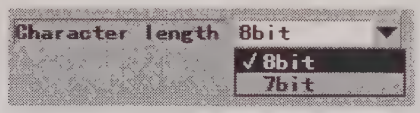
- 300 bit/s
- 600 bit/s
- 1200 bit/s
- 2400 bit/s
- 4800 bit/s
- 9600 bit/s
- 19200 bit/s



(3) Character length

Set the character length to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

- 7 bit
- 8 bit



(4) Stop bit

Set the stop bit length to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

- 1 bit
- 2 bit

(5) Flow control

Set the flow control to either value among the following. When the bar showing the setting is clicked, a list of selectable values. Select the value.

- X-ON/OFF
- Ready/Busy

To control the MP1570A using the GPIB or RS232C interface, the above setting should meet those setting in the MP1570A. For the setting of the MP1570A, refer to the MP1570A Operation Manual.

To control the MP1570A using the GPIB interface, the GPIB board manufactured by National Instruments Ltd. and the driver must be installed and enabled. For installation method of the GPIB board, refer to the operation manual that comes with the board.

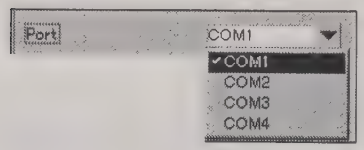
3.11.3 Detailed Setting of RS232C Interface for Measurement

Only Speed can be set for the RS232C interface for Measurement. Setting conditions cannot be changed for other items.

(1) Port

Set the port to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

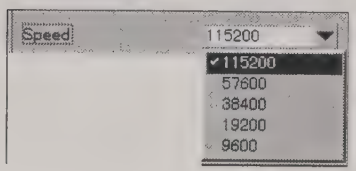
- COM1
- COM2
- COM3
- COM4



(2) Speed

Set the baud rate to either value among the following. When the bar showing the setting is clicked, a list of selectable values appears. Select the value.

- 9600 bit/s
- 19200 bit/s
- 38400 bit/s
- 57600 bit/s
- 115200 bit/s



(3) Character length

The set value of the character length is shown, however, the setting cannot be changed.

- 8 bit

(4) Stop bit

The set value of the stop bit length is shown, however, the setting cannot be changed.

- 1 bit

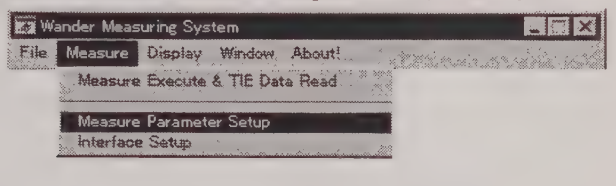
All the setting of the RS232C interface for Wander setting data transfer is performed via this system. Interface setting cannot be changed in the MP1570A.

3.12 Setting of Measurement Parameters

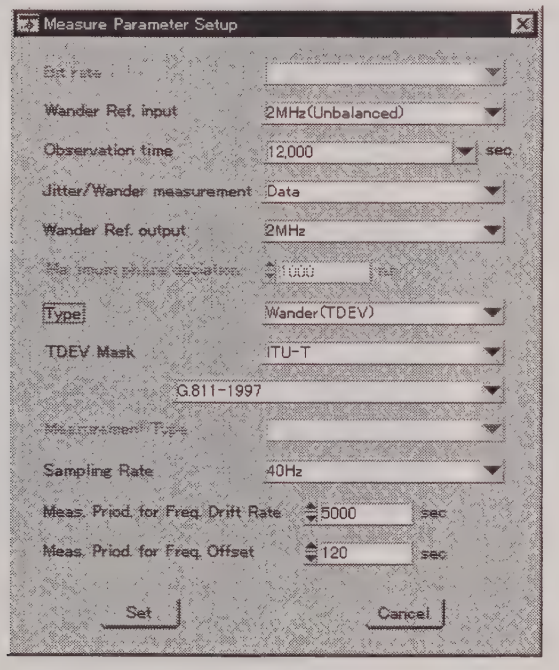
Set the information necessary to measure a TIE data to the MP1570A.

The following instructs the setting procedure.

(1) Select [Measure Parameter Setup] from the [Measure] menu in the main window.



(2) The measurement parameter setup window appears. Settable items differ depending on the units installed. Shaded items cannot be set.



(3) Set data. For details, refer to 3.12.1 [Detailed setting of measurement parameter].

(4) When the setting has been completed, click on the [Set] button in the Measure Parameter Setup window to set them to the MP1570A. When the setting has been applied to the MP1570A, the main window appears. To cancel setting, click on the [Cancel] button in the Measure Parameter Setup window. All the input information is deleted and the main window appears.

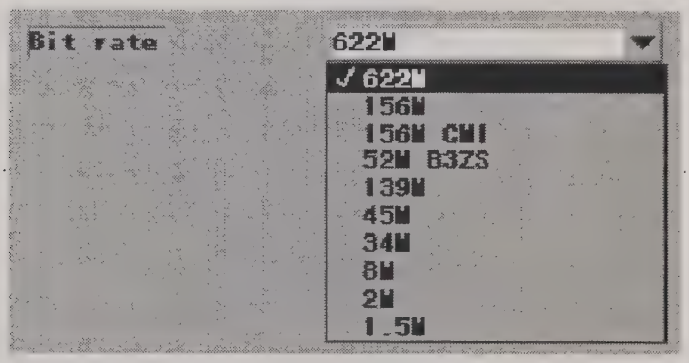
3.12.1 Detailed Setting of Measurement Parameter

The following items can be set.

(1) Bit rate

Set the measurement signal to either value among the following. The settable value, however, differs depending on the units installed. When the bar showing the setting is clicked, a list of selectable value appears. Select the value.

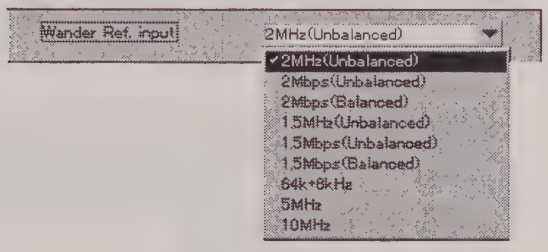
- 2488 M
- 622 M
- 156 M
- 156 M CMI
- 52 M B3ZS
- 52 M
- 139 M
- 45 M
- 34 M
- 8 M
- 2 M
- 1.5 M



(2) Wander Ref. Input

Set the Wander Ref. Input to either value among the following. When the bar showing the setting is clicked, a list of selectable value appears. Select the value.

- 2 MHz (Unbalanced)
- 2 Mbit/s (Unbalanced)
- 64 k + 8 KHz
- 2 Mbit/s (Balanced)
- 1.5 MHz (Unbalanced)
- 5 MHz
- 1.5 Mbit/s (Unbalanced)
- 1.5 Mbit/s (Balanced)
- 10 MHz



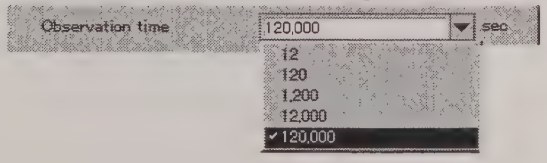
(3) Observation time

Set the measurement time within the following range:

- 12 sec
- 120 sec
- 1,200 sec
- 12,000 sec
- 120,000 sec

or

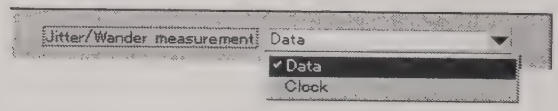
- 10 to 100 sec/Step 10 sec
- 100 to 1,000 sec/Step 100 sec
- 1,000 to 10,000 sec/Step 1,000 sec
- 10,000 to 100,000 sec/Step 10,000 sec
- 100,000 to 1,000,000 sec/Step 100,0000 sec
- 1,000,000 to 10,000,000 sec/Step 1,000,000 sec
- 10,000,000 to 100,000,000 sec/Step 10,000,000 sec



(4) Jitter/Wander measurement

Set the measured signal to either of the following. When the bar showing the setting is clicked, a list of selectable value appears. Select the value.

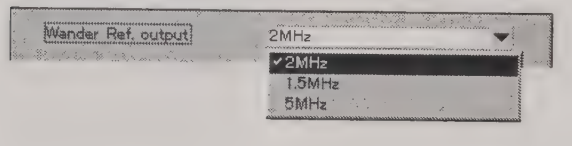
- Data
- Clock



(5) Wander Ref. Output

Set the Wander reference signal output to either of the following. When the bar showing the setting is clicked, a list of selectable value appears. Select the value.

- 1.5 MHz
- 2 MHz
- 5 MHz



(6) Type

Select whether TDEV Mask pattern to be set for the Wander reference signal output when Wander is selected in the Test menu.

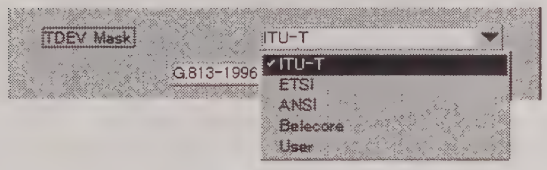
This parameter can be set only when the Wander measurement is selected in the Test menu.

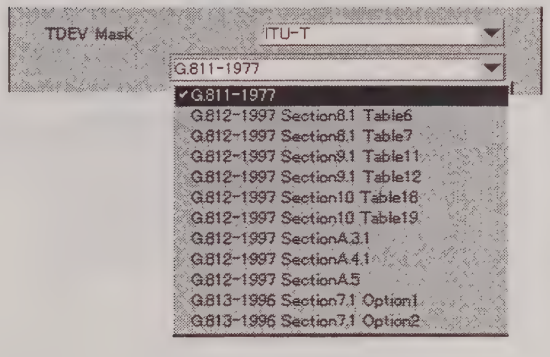
(7) TDEV Mask

Set the TDEV Mask pattern for the Wander reference signal output.

When the bar indicating the setting is clicked, a list of selectable values appears. Select the value. For details, refer to [TDEV graph and system-fixed mask] of subsection 3.14.5, "Mask."

When use the User setting, previously perform the User setting, by selecting Type = TDEV Mask for Jitter/Wander in the Setup window of the MP1570A. Conditions for User setting cannot be changed via this system.





This measurement parameter can be set only when [Wander], [Wander tolerance (TDEV)] and [Wander transfer (TDEV)] are selected in the Test menu.

3.13 Measurement Execution and Data Read from the MP1570A

Measurement can be started with the measurement parameter currently set, and the TIE measurement data can be read using the RS232C interface for Wander measurement data transfer during measurement.

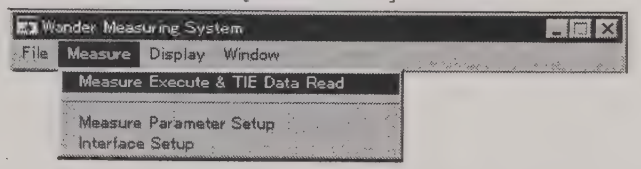
The following method allows to execute measurement and to read data from the MP1570A:

Measurement execution and data read from the MP1570A

The following instructs the procedure:

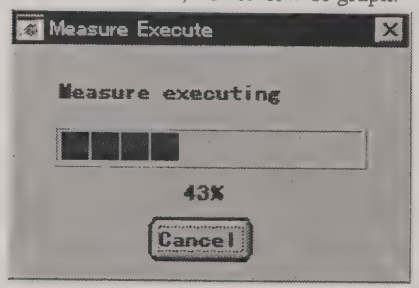
3.13.1 Measurement Execution and Data Read from the MP1570A

(1) Select [Measure Execute & TIE Data Read] from the [Measure] menu in the main window or click on the [Measure Start] button.



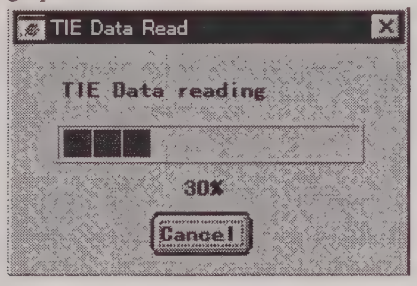
or

(2) Start measurement using the parameters currently set in the MP1570A. A window indicating the measurement status is displayed during measurement. The TIE graph window automatically appears and the graph is updated according to the measurement progress. For overviews of the TIE graph window, refer to subsection 3.14.1, "Overview of graph."



(3) To cancel measuring, click on the [Cancel] button in the Measure Execute window shown above. Measurement stops and the main window appears. The data measured up to that point is shown.

(4) The TIE measurement data is read during measurement. During reading, a window indicating the reading status is displayed. The TIE graph window automatically appears and the graph is updated according to the measurement progress. For overviews of the TIE graph window, refer to subsection 3.14.1, "Overview of graph."



(5) To cancel reading, click on the [Cancel] button in the TIE Data Read window shown above. Reading stops and the main window appears. The data read up to that point is shown.

(6) When reading has been completed, the main window appears.

3.14 Graph

A graph can be displayed based on the read data. Five types of graphs can be displayed: TIE, MTIE, TDEV, Wander tolerance (TDEV), and Wander transfer (TDEV).

This section describes the following:

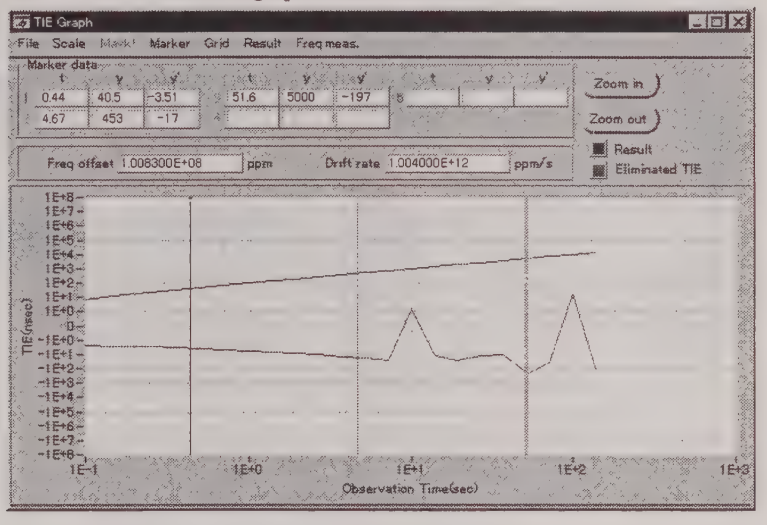
1) Overview of graph
2) Display of graph
3) Closing of graph
4) Replacing of graphs
5) Mask
6) Marker
7) Scale and zoom
8) Calculation points

3.14.1 Overview of Graph

A graph is displayed in a window other than the main window.
The following describes the overview of respective graphs.

(1) TIE graph

The overview of the TIE graph is described below:



A TIE graph is drawn based on a read TIE measurement data or read TIE graph data. Vertical axis is log scale (upward and downward), and horizontal axis is can be selected either ordinary log scale of logarithmic graph or Linear scale of graph display. The vertical axis indicates TIE values, and the horizontal axis indicates Observation Time.

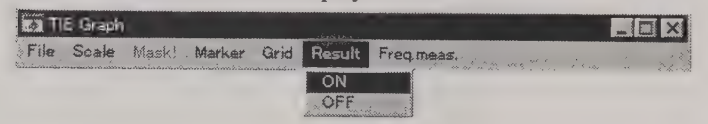
The graph indicates the calculation values done at points specified based on current observation time. Also, the graph indicates all points linked using straight lines.

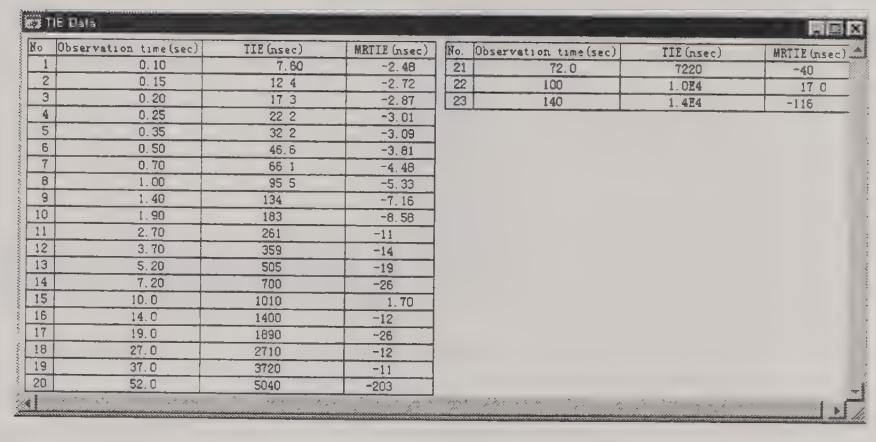
In the [Marker Data] pane in the upper of the window, values are displayed when the marker is set. From the upper left, the values indicate marker 1, marker 2, marker 3, marker 4, and marker 5 in the order. A numerical-value display area of a marker consists of [t], [y], and [y']. [t], [y], and [y'] represent Observation Time, TIE value, and MRTIE value, respectively. For details of markers, refer to 3.14.7 "Marker."
Freq offset and Drift rate are displayed at the same time.

(2) MRTIE

When [Freq. drift rate ON] and [Freq. offset ON] are checked from the [Freq. Meas.] menu in the title bar, the calculation results are displayed. Checking [Freq. offset ON] allows simultaneous display of the value from which errors by Freq. offset are eliminated (eliminate TIE).

By selecting [ON] from the [Result] menu in the title bar, results in not only graph, but also numerical value can be displayed.



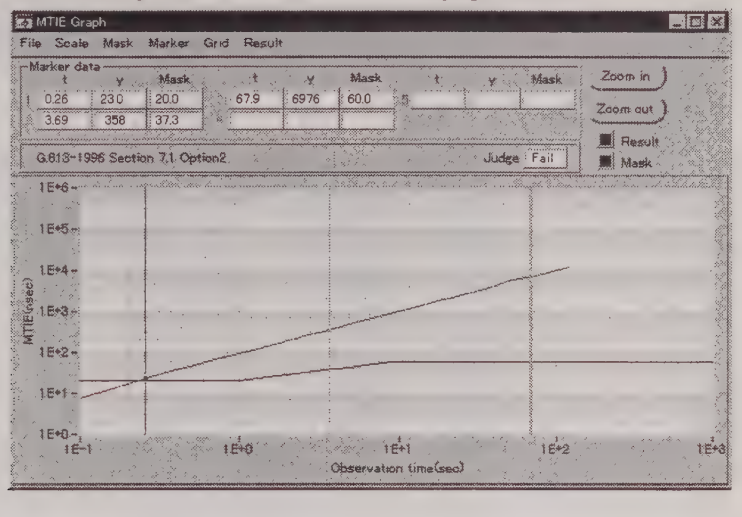


No	Observation time(sec)	TIE(nsec)	MRTIE(nsec)
1	0.10	7.60	-2.48
2	0.15	12.4	-2.72
3	0.20	17.3	-2.87
4	0.25	22.2	-3.01
5	0.35	32.2	-3.09
6	0.50	46.6	-3.81
7	0.70	66.1	-4.48
8	1.00	95.5	-5.33
9	1.40	134	-7.16
10	1.90	183	-8.58
11	2.70	261	-11
12	3.70	359	-14
13	5.20	505	-19
14	7.20	700	-26
15	10.0	1010	1.70
16	14.0	1400	-12
17	19.0	1890	-26
18	27.0	2710	-12
19	37.0	3720	-11
20	52.0	5040	-203

No.	Observation time(sec)	TIE(nsec)	MRTIE(nsec)
21	72.0	7220	-40
22	100	1.0E4	17.0
23	140	1.4E4	-116

(3) MTIE graph

The following is the overview of the MTIE graph window.



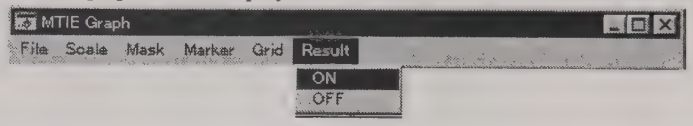
An MTIE graph is drawn based on a read MTIE graph data.

Vertical and horizontal axes are ordinary log scale of logarithmic graph. The vertical axis indicates MTIE values, and the horizontal axis indicates Observation Time.

The graph indicates the calculation values done at points specified based on current observation time. Also, the graph indicates all points linked using straight lines.

In the [Marker Data] pane on top of the window, values are displayed when the marker is set. From the upper left, the values indicate marker 1, marker 2, marker 3, marker 4, and marker 5 in that order. A numerical-value display area of a marker consists of [t], [y], and [Mask]. [t], [y], and [Mask] represent Observation Time, MTIE value, and Mask value, respectively. For details of Mask, refer to 3.14.5, "Mask." For details of markers, refer to subsection 3.14.7, "Marker."

By selecting [ON] from the [Result] menu in the title bar, results in numerical value besides graph can be displayed.



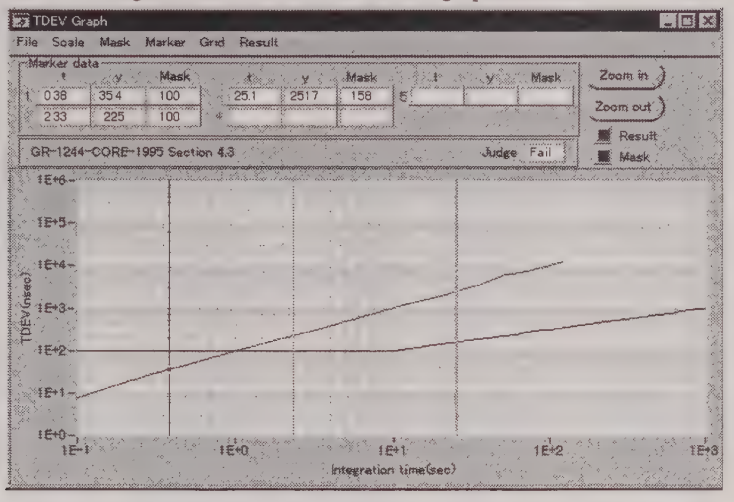
MTIE Data

No	Observation time (sec)	MTIE (nsec)	Judge
1	0.10	7.60	Pass
2	0.15	12.4	Pass
3	0.20	17.3	Pass
4	0.25	22.2	Fail
5	0.35	32.2	Fail
6	0.50	46.6	Fail
7	0.70	66.1	Fail
8	1.00	95.5	Fail
9	1.40	134	Fail
10	1.90	183	Fail
11	2.70	261	Fail
12	3.70	359	Fail
13	5.20	505	Fail
14	7.20	700	Fail
15	10.0	1010	Fail
16	14.0	1400	Fail
17	19.0	1890	Fail
18	27.0	2710	Fail
19	37.0	3720	Fail
20	52.0	6040	Fail

No.	Observation time (sec)	MTIE (nsec)	Judge
21	72.0	7220	Fail
22	100	1.0E4	Fail
23	120	1.2E4	Fail

(4) TDEV graph

The following is the overview of the TDEV graph window.



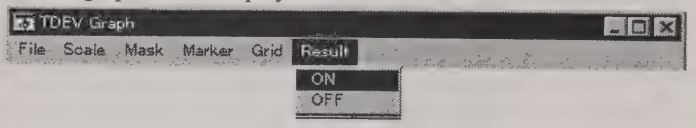
A TDEV graph is drawn based on a read TDEV graph data.

Vertical and horizontal axes are ordinary log scale of logarithmic graph. The vertical axis indicates TDEV values, and the horizontal axis indicates Integration Time.

The graph indicates the calculation values done at points specified based on current observation time. Also, the graph indicates all points linked using straight lines.

In the [Marker Data] pane on top of the window, values are displayed when the marker is set. From the upper left, the values indicate marker 1, marker 2, marker 3, marker 4, and marker 5 in the order. A numerical-value display area of a marker consists of [t], [y], and [Mask]. [t], [y], and [Mask] represent Integration Time, TDEV value, and Mask value, respectively. For details of Mask, refer to 3.14.5, "Mask." For details of markers, refer to 3.14.7, "Marker."

By selecting [ON] from the [Result] menu in the title bar, results in numerical value besides graph can be displayed.

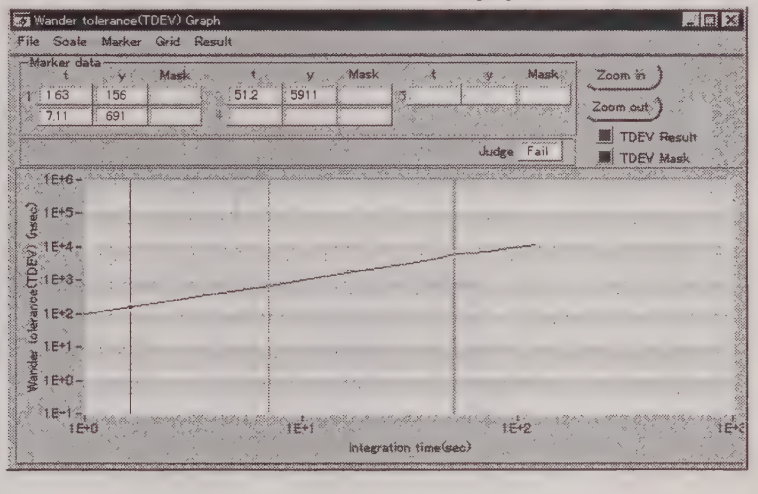


TDEV Data

No	Integration time(sec)	TDEV(nsec)	Judge
1	0.10	7.60	Pass
2	0.15	12.4	Pass
3	0.20	17.3	Pass
4	0.25	22.2	Pass
5	0.35	32.2	Pass
6	0.50	46.6	Pass
7	0.70	66.1	Pass
8	1.00	95.5	Pass
9	1.40	134	Fail
10	1.90	183	Fail
11	2.70	261	Fail
12	3.70	359	Fail
13	5.20	505	Fail
14	7.20	700	Fail
15	10.0	1010	Fail
16	14.0	1400	Fail
17	19.0	1890	Fail
18	27.0	2710	Fail
19	37.0	3720	Fail
20	52.0	6040	Fail
21	72.0	7220	Fail
22	100	1.0E4	Fail
23	120	1.2E4	Fail

(5) Wander tolerance (TDEV)

The overview of the Wander tolerance (TDEV) graph window is described below:



A Wander tolerance (TDEV) graph is drawn based on a read Wander tolerance (TDEV) graph data.

Vertical and horizontal axes are ordinary log scale of logarithmic graph. The vertical axis indicates TDEV values, and the horizontal axis indicates Integration Time.

The graph indicates the calculation values done at points specified based on current observation time. Also, the graph indicates all points linked using straight lines.

In the [Marker Data] pane in the upper of the window, values are displayed when the marker is set. From the upper left, the values indicate marker 1, marker 2, marker 3, marker 4, and marker 5 in the order. A numerical-value display area of a marker consists of [t], [y], and [Mask]. [t] and [y] represent Observation Time and TDEV value, respectively. [Mask] is not used in the Wander tolerance (TDEV) graph. For details of markers, refer to 3.14.7, "Marker."

By selecting [ON] from the [Result] menu in the title bar, results in numerical value besides graph can be displayed.

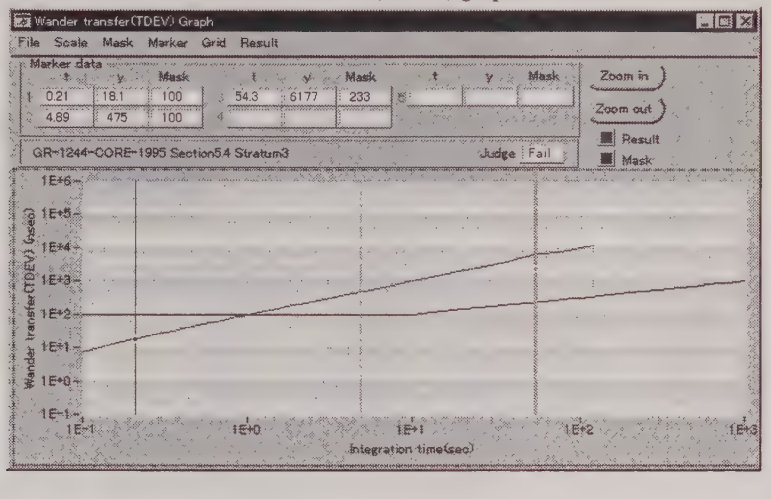
Wander tolerance (TDEV) is judged depending on whether error occurs during the measurement time and the results are displayed in the upper right of the graph.

Wander tolerance(TDEV) Data

No.	Integration time(sec)	Tolerance TDEV(nsec)	Judge
1	0.10	7.60	---
2	0.15	12.4	---
3	0.20	17.3	---
4	0.25	22.2	---
5	0.35	32.2	---
6	0.50	46.6	---
7	0.70	66.1	---
8	1.00	95.5	---
9	1.40	134	---
10	1.90	183	---
11	2.70	261	---
12	3.70	359	---
13	5.20	505	---
14	7.20	700	---
15	10.0	1010	---
16	14.0	1400	---
17	19.0	1890	---
18	27.0	2710	---
19	37.0	3720	---
20	52.0	6040	---
21	72.0	7220	---
22	100	1.0E4	---
23	120	1.2E4	---

(6) Wander transfer (TDEV)

The overview of the Wander transfer (TDEV) graph window is described below:



A Wander tolerance (TDEV) graph is drawn based on a read Wander tolerance (TDEV) graph data.

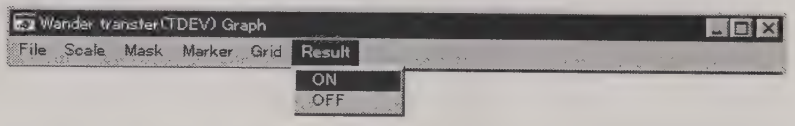
Vertical and horizontal axes are ordinary log scale of logarithmic graph. The vertical axis indicates TDEV values, and the horizontal axis indicates Integration Time.

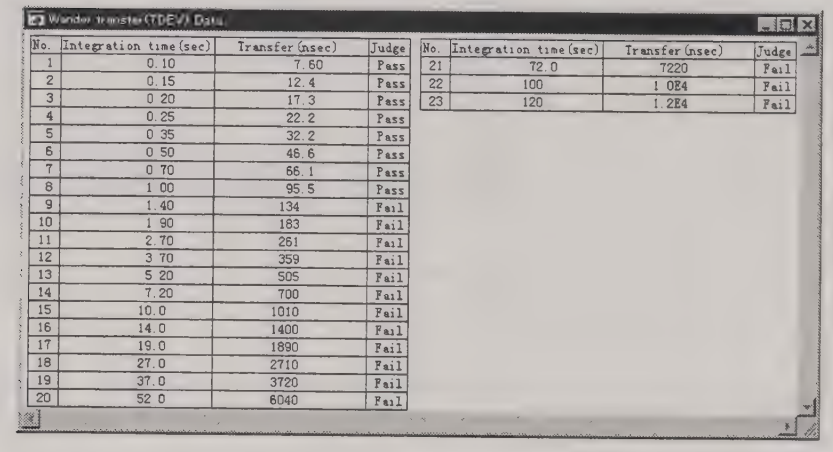
The graph indicates the calculation values done at points specified based on current observation time. Also, the graph indicates all points linked using straight lines.

In the [Marker Data] frame in the upper of the window, values are displayed when the marker is set. From the upper left, the values indicate marker 1, marker 2, marker 3, marker 4, and marker 5 in the order. A numerical-value display area of a marker consists of [t], [y], and [Mask]. [t], [y], and [Mask] represent Integration Time and TDEV value, and Mask value, respectively. For details of Mask, refer to 3.14.5, "Mask." For details of markers, refer to 3.14.7, "Marker."

By selecting [ON] from the [Result] menu in the title bar, results in numerical value besides graph can be displayed.

Wander Transfer (TDEV) measurement requires calibration performed before starting measurement.





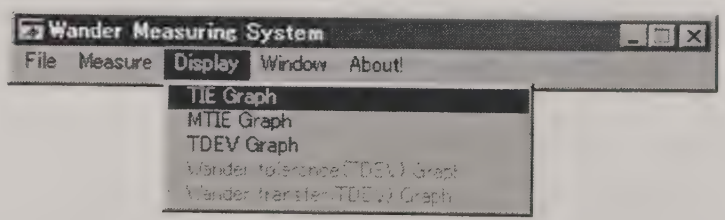
No.	Integration time (sec)	Transfer (nsec)	Judge
1	0.10	7.60	Pass
2	0.15	12.4	Pass
3	0.20	17.3	Pass
4	0.25	22.2	Pass
5	0.35	32.2	Pass
6	0.50	46.6	Pass
7	0.70	66.1	Pass
8	1.00	95.5	Pass
9	1.40	134	Fail
10	1.90	183	Fail
11	2.70	261	Fail
12	3.70	359	Fail
13	5.20	505	Fail
14	7.20	700	Fail
15	10.0	1010	Fail
16	14.0	1400	Fail
17	19.0	1890	Fail
18	27.0	2710	Fail
19	37.0	3720	Fail
20	52.0	6040	Fail
21	72.0	7220	Fail
22	100	1.0E4	Fail
23	120	1.2E4	Fail

3.14.2 Display of Graph

How to display a graph window is explained below.

(1) Select [Display] in the main window. The following menu is displayed. Select the desired graph: [TIE Graph] for a TIE graph, [MTIE Graph] for an MTIE graph, [TDEV Graph] for a TDEV graph, [Wander tolerance (TDEV) Graph] for a Wander tolerance (TDEV) graph, or [Wander transfer (TDEV) Graph] for a Wander transfer (TDEV) graph. If either graph window is indicated, the corresponding item is checked. Note that the graph window currently indicated will close if the checked item is clicked again.

Also, note that graphs that can be indicated differ depending on the measurement menu selected in the Test menu.

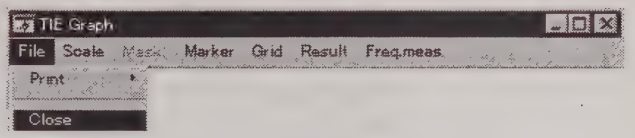


(2) The checked graph window is displayed. For overviews of each graph window, refer to subsection 3.14.1, "Overview of graph."

3.14.3 Closing of Graph

How to close a graph window is explained below.

(1) Select [Close] from the [File] menu in each graph window.

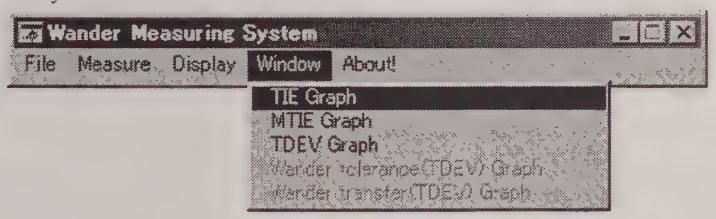


(2) Graph window is closed, and the main window is displayed.

3.14.4 Replacing of Graph

When multiple graph windows are displayed simultaneously, a target window can be displayed on top of the windows.
Operations are as follows:

(1) Select [Window] in the main window. The following menu appears. Only the menus currently displayed can be selected. To display TIE graph, MITE graph, or TDEV graph; select [TIE Graph], [MTIE Graph], or [TDEV Graph], respectively.



(2) A target graph window is displayed on top of the windows. For overview of each graph window, refer to 3.14.1, "Overview of graph."

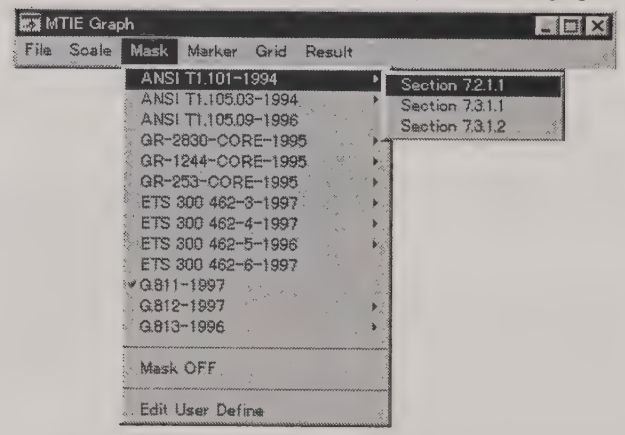
3.14.5 Mask

All the graphs except for TIE graph allow displaying a mask line indicating a specification location on the graphs. Two types of masks are provided: system-specified and user-defined.

The following instructions are described.
(1) Displaying the system-fixed mask
(2) Displaying the user-defined mask
(3) Turning off mask line
(4) Setting the user-defined mask

(1) Displaying the system-fixed mask

(a) Select [Mask] from the graph window. The following menu appears. A list of the system-fixed mask to be selected is displayed. Select a target mask. When a mask is selected, the mask line appears on the graph.



The selectable masks differ depending on the graph. A list of system-fixed masks for each graph follows:

MTIE graph and system-fixed mask

Mask Name		Mask Formula	
ANSI T1.101-1994	Section 7.2.1.1	MTIE (τ) = 300 + 2.5τ	0.05 < τ < 280
		MTIE (τ) = 997 + 0.01τ	280 < τ
	Section 7.3.1.1	MTIE (t) = 70 + 3.32τ	0.05 < τ < 280
		MTIE (τ) = 999 + 0.01τ	280 < τ
	Section 7.3.1.2	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.5
		MTIE (τ) = 300 + 300τ	0.5 < τ < 2.33
		MTIE (τ) = 1000	2.33 < τ < 280
		MTIE (τ) = 997 + 0.01τ	280 < τ
ANSI T1.105.03-1994	Section 7.1	MTIE (τ) = 61000τ	0.001326 < τ < 0.0115
		MTIE (τ) = 700	τ > 0.0115
	Section 7.2.1	MTIE (τ) = 61000τ	0.001326 < τ < 0.0164
		MTIE (τ) = 925 + 4600τ	0.0164 < τ < 0.93
		MTIE (τ) = 5200	τ > 0.93
	Section 7.2.2	MTIE (τ) = 6100τ	0.001326 < τ < 0.0164
		MTIE (τ) = 925 + 4600τ	0.0164 < τ < 1.97
		MTIE (τ) = 10,000	1.97 < τ
	Section 8.1	MTIE (τ) = 20	0.1 < τ < 0.25
		MTIE (τ) = 53τ + 7	0.25 < τ < 1
		MTIE (τ) = 37$\tau^{0.5}$ + 23	1 < τ < 10
		MTIE (τ) = 140	10 < τ < 100
	Section 8.2.1	MTIE (τ) = 945τ	0.1 < τ < 0.18
		MTIE (τ) = 170	0.18 < τ < 100
	Section 8.2.2	MTIE (τ) = 1820τ	0.1 < τ < 0.28
		MTIE (τ) = 510	0.28 < τ < 100
	Section 8.2.3	MTIE (τ) = 1650τ	0.1 < τ < 0.70
		MTIE (τ) = 1155	0.70 < τ < 100
	Section 8.2.4	MTIE (τ) = 1830τ	0.1 < τ < 0.44
		MTIE (τ) = 800	0.44 < τ < 100
	Section D.2.1 Normal Condition.	MTIE (τ) = 70 + 3.32τ	0.05 < τ < 280
		MTIE (τ) = 999 + 0.01τ	280 < τ
	Section D.2.1 phase transients	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.5
		MTIE (τ) = 300 + 300τ	0.5 < τ < 2.33
		MTIE (τ) = 1000	2.33 < τ < 280
		MTIE (τ) = 997 + 0.01τ	280 < τ
	Section D.2.2.1	MTIE (τ) = 300 + 2.5τ	0.05 < τ < 280
		MTIE (τ) = 997 + 0.01τ	280 < τ
ANSI T1.105.09-1996		MTIE (τ) = 7.6 + 885τ	0.014 ≤ τ < 0.5
		MTIE (τ) = 300 + 300τ	0.5 ≤ τ < 2.33
		MTIE (τ) = 884 + 50τ	2.33 ≤ τ < 64

Mask Name		Mask Formula	
GR-2830-CORE-1995	Section 6.5.2	MTIE (τ) = 10 + 0.29τ	0.05 < τ < 1000
	Fig.6-1 Normal MTIE	MTIE (τ) = 290 + 0.01τ	1000 < τ
	Section 6.5.2	MTIE (τ) = 150 + 2.9τ	0.05 < τ < 4000
	Fig.6-1 Degraded MTIE	MTIE (τ) = 7000 + τ	4000 < τ
	Section 6.5.2	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.16
	Fig.6-3	MTIE (τ) = 150	0.16 < τ < 400
GR-1244-CORE-1995	Section 5.3	MTIE (τ) = 40	0.1 < τ < 1
	Limited Temp.	MTIE (τ) = 40$\tau^{0.40}$	1 < τ < 10
		MTIE (τ) = 100	10 < τ
	Section 5.3	MTIE (τ) = 40	0.1 < τ < 1
	Var. Temp.	MTIE (τ) = 40$\tau^{0.40}$	1 < τ < 10
		MTIE (τ) = 100	10 < τ < 1000
		MTIE (τ) = 3.16$\tau^{0.5}$	1000 < τ
	Section 5.7	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.16
		MTIE (τ) = 150	0.16 < τ
GR-253-CORE-1995	Section 5.4.4.2.2	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.5
		MTIE (τ) = 300 + 300τ	0.5 < τ < 2.33
		MTIE (τ) = 884 + 50τ	2.33 < τ < 64
	Section 5.4.4.3.2	MTIE (τ) = 20	0.1 < τ < 1
		MTIE (τ) = 20$\tau^{0.48}$	1 < τ < 10
		MTIE (τ) = 60	10 < τ
	Section 5.4.4.3.3	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.5
	Required	MTIE (τ) = 300 + 300τ	0.5 < τ < 2.33
		MTIE (τ) = 1000	2.33 < τ < 280
	Section 5.4.4.3.3	MTIE (τ) = 7.6 + 885τ	0.014 < τ < 0.16
	Objective	MTIE (τ) = 150	0.16 < τ < 280
	Section 5.7.1	MTIE (τ) = 61000τ	0.001326 < τ < 0.0115
		MTIE (τ) = 700	0.0115 < τ
	Section 5.7.2.1	MTIE (τ) = 61000τ	0.001326 < τ < 0.0164
		MTIE (τ) = 925 + 4600τ	0.0164 < τ < 0.93
		MTIE (τ) = 5200	0.93 < τ
	Section 5.7.2.2	MTIE (τ) = 6100τ	0.01326 < τ < 0.0164
		MTIE (τ) = 925 + 4600τ	0.0164 < τ < 1.97
		MTIE (τ) = 10000	1.97 < τ

Mask Name		Mask Formula	
ETS 300 462-3-1997	Section 7.2.1	MTIE (τ) = 25	$0.1 < \tau \leq 83$
		MTIE (τ) = 0.3τ	$83 < \tau \leq 1000$
		MTIE (τ) = 300	$1000 < \tau \leq 30000$
		MTIE (τ) = 0.01τ	$30000 < t$
	Section 7.2.2	MTIE (t) = 25	$0.1 < \tau \leq 2.5$
		MTIE (τ) = 10τ	$2.5 < \tau \leq 200$
		MTIE (τ) = 2000	$200 < \tau \leq 2000$
		MTIE (τ) = $433\tau^{0.2} + 0.01\tau$	$2000 < \tau$
	Section 7.2.3	MTIE (τ) = 250	$0.1 < \tau \leq 2.5$
		MTIE (τ) = 100τ	$2.5 < \tau \leq 20$
		MTIE (τ) = 2000	$20 < \tau \leq 2000$
		MTIE (τ) = $433\tau^{0.2} + 0.01\tau$	$2000 < \tau$
	Section 7.2.4	MTIE (τ) = 732	$0.1 < \tau \leq 7.3$
		MTIE (τ) = 100τ	$7.3 < \tau \leq 20$
		MTIE (τ) = 2000	$20 < \tau \leq 2000$
		MTIE (τ) = $433\tau^{0.2} + 0.01\tau$	$2000 < \tau$
ETS 300 462-4-1997	Section 6.1 Const.Temp	MTIE (τ) = 24	$0.1 < \tau \leq 9$
		MTIE (τ) = $8\tau^{0.5}$	$9 < \tau \leq 400$
		MTIE (τ) = 160	$400 < \tau \leq 10000$
	Section 6.1 Var.Temp	MTIE (τ) = 24	$0.1 < \tau \leq 9$
		MTIE (τ) = $8\tau^{0.5}$	$9 < \tau \leq 400$
		MTIE (τ) = 160	$400 < \tau \leq 2500$
		MTIE (τ) = $3.2\tau^{0.5}$	$2500 < \tau < 10000$
	Section 7.2	MTIE (τ) = 750	$0.1 < \tau \leq 7.5$
		MTIE (τ) = 100τ	$7.5 < \tau \leq 20$
		MTIE (τ) = 2000	$20 < \tau \leq 400$
		MTIE (τ) = 5τ	$400 < \tau \leq 1000$
		MTIE (τ) = 5000	$1000 < \tau \leq 10000$
ETS 300 462-5-1996	Section 6.1 Const.Temp	MTIE (τ) = 40	$0.1 < \tau \leq 1$
		MTIE (τ) = $40\tau^{0.1}$	$1 < \tau \leq 100$
		MTIE (τ) = $25\tau^{0.2}$	$100 < \tau \leq 1000$
	Section 6.1 Var.Temp	MTIE (t) = $40 + 0.5\tau$	$0.1 < \tau \leq 1$
		MTIE (t) = $40\tau^{0.1} + 0.5\tau$	$1 < \tau \leq 100$
		MTIE (τ) = $50 + 25\tau^{0.2}$	$100 < \tau \leq 1000$
	Section 7.2	MTIE (τ) = 250	$0.1 < \tau \leq 2.5$
		MTIE (τ) = 100τ	$2.5 < \tau \leq 20$
		MTIE (τ) = 2000	$20 < \tau \leq 400$
		MTIE (τ) = 5τ	$400 < \tau \leq 1000$

Mask Name		Mask Formula	
ETS 300 462-6-1997		MTIE (τ) = 0.275τ + 25	0.1 < τ ≤ 1000
		MTIE (τ) = 0.01τ + 290	1000 < τ
G.811-1997		MTIE (τ) = 0.275τ + 25	0.1 < τ ≤ 1000
		MTIE (τ) = 0.01τ + 290	1000 < τ
G.812-1997	Section 8.1 Table3	MTIE (τ) = 24	0.1 < τ ≤ 9
		MTIE (τ) = $8\tau^{0.5}$	9 < τ ≤ 400
		MTIE (τ) = 160	400 < τ ≤ 10000
	Section 8.1 Table4	MTIE (τ) = 40	0.1 < τ ≤ 1
		MTIE (τ) = $40\tau^{0.4}$	1 < τ ≤ 10
		MTIE (τ) = 100	10 < τ
	Section 8.1 Table5	MTIE (τ) = 24	0.1 < τ ≤ 9
		MTIE (τ) = $8\tau^{0.5}$	9 < τ ≤ 400
		MTIE (τ) = 160	400 < τ ≤ 2500
		MTIE (τ) = $3.2\tau^{0.5}$	2500 < τ ≤ 10000
	Section 9.1 Table 9	MTIE (τ) = 750	0.1 < τ ≤ 7.5
		MTIE (τ) = 100τ	7.5 < τ ≤ 20
		MTIE (τ) = 2000	20 < τ ≤ 400
		MTIE (τ) = 5τ	400 < τ ≤ 1000
		MTIE (τ) = 5000	1000 < τ ≤ 10000
	Section 9.1 Table 10	MTIE (τ) = 300 + 2.5τ	0.05 < τ ≤ 280
		MTIE (τ) = 997 + 0.01τ	280 < τ
	Section 11.1.1	MTIE (τ) = 25	0.001 < τ ≤ 0.0033
		MTIE (τ) = 7500τ	0.0033 < τ ≤ 0.016
		MTIE (τ) = 120 + 0.5τ	0.016 < τ ≤ 240
		MTIE (τ) = 240	240 < t ≤ 1000
	Section 11.1.2	MTIE (τ) = 7500τ	0.001 < τ ≤ 0.016
		MTIE (τ) = 120 + 0.5τ	0.016 < τ ≤ 240
		MTIE (τ) = 240	240 < τ ≤ 10000
	Section 11.1.3	MTIE (τ) = 40 + 885τ	0.014 < τ ≤ 0.16
		MTIE (τ) = 182	0.16 < τ ≤ 280
	Section 11.1.4	MTIE (τ) = 7.6 + 885τ	0.014 < τ ≤ 0.16
		MTIE (τ) = 150	0.16 < τ ≤ 280
	Section 11.4 Table 26	MTIE (τ) = 60	τ ≤ 0.001
		MTIE (τ) = 120	0.001 < τ ≤4
		MTIE (τ) = 240	4 < τ
	Section 11.4 Table 27	MTIE (τ) = 61000τ	0.00133 < τ ≤ 0.0164
		MTIE (τ) = 1000	0.0164 < τ

Mask Name		Mask Formula	
G.812-1997	Section A.3.1 Table A.3	MTIE (τ) = 40	$0.1 < \tau \leq 1$
		MTIE (τ) = $40\tau^{0.4}$	$1 < \tau \leq 10$
		MTIE (τ) = 100	$10 < \tau$
	Section A.3.1 Table A.4	MTIE (τ) = 1000	$100 < \tau$
	Section A.4.1	MTIE (τ) = $300 + 2.5\tau$	$0.05 < \tau \leq 280$
		MTIE (τ) = $997 + 0.01\tau$	$280 < \tau$
	Section A.6.1.1	MTIE (τ) = 61000τ	$0.00133 \leq \tau \leq 0.0164$
		MTIE (τ) = 1000	$0.0164 < \tau$
	Section A.6.1.2	MTIE (τ) = $7.6 + 885\tau$	$0.014 < \tau \leq 0.5$
		MTIE (τ) = $300 + 300\tau$	$0.5 < \tau \leq 2.33$
		MTIE (τ) = 1000	$2.33 < \tau \leq 280$
	Section A.6.1.3	MTIE (τ) = 25	$0.001 < \tau \leq 0.0033$
		MTIE (τ) = 7500τ	$0.0033 < \tau \leq 0.016$
		MTIE (τ) = $120 + 0.5\tau$	$0.016 < \tau \leq 240$
		MTIE (τ) = 240	$240 < \tau \leq 10000$
	Section A.6.1.4	MTIE (τ) = 7500τ	$0.001 < \tau \leq 0.016$
		MTIE (τ) = $120 + 0.5\tau$	$0.016 < \tau \leq 240$
		MTIE (τ) = 240	$240 < \tau \leq 10000$
	Section A.6.4 TableA.19	MTIE (τ) = 61000τ	$0.00133 < \tau \leq 0.0164$
		MTIE (τ) = 1000	$0.0164 < \tau$
	Section A.6.4 Table A.20	MTIE (τ) = 61	$\tau \leq 0.001$
		MTIE (τ) = 61000τ	$0.001 < \tau \leq 0.0164$
		MTIE (τ) = 1000	$0.0164 < \tau$
G.813-1996	Section 7.1 Option1 Const.Temp	MTIE (τ) = 40	$0.1 < \tau \leq 1$
		MTIE (τ) = $40\tau^{0.1}$	$1 < \tau \leq 100$
		MTIE (τ) = $25.25\tau^{0.2}$	$100 < \tau < 1000$
	Section 7.1 Option1 Var.Temp	MTIE (τ) = $40 + 0.5\tau$	$0.1 < \tau \leq 1$
		MTIE (τ) = $40t^{0.1} + 0.5\tau$	$1 < \tau \leq 100$
		MTIE (τ) = $25.25\tau^{0.2} + 50$	$100 < \tau$
	Section 7.1 Option2	MTIE (τ) = 20	$0.1 < \tau \leq 1$
		MTIE (τ) = $20\tau^{0.48}$	$1 < \tau \leq 10$
		MTIE (τ) = 60	$10 < \tau \leq 1000$

TDEV graph and system-fixed mask

Mask Name		Mask Formula	
ANSI T1.101-1994	Section 7.2.2	TDEV (τ) = 100	$0.05 < \tau < 10$
		TDEV (τ) = $31.6\tau^{0.5}$	$10 < \tau < 1000$
	Section 7.3.2	TDEV (τ) = 10	$0.05 < \tau < 1.73$
		TDEV (τ) = 5.77τ	$1.73 < \tau < 30$
		TDEV (τ) = $31.6\tau^{0.5}$	$30 < \tau < 1000$
ANSI T1.105-03-1994	Section D.2.1	TDEV (τ) = 10	$0.05 < \tau < 1.73$
		TDEV (τ) = 5.77τ	$1.73 < \tau < 30$
		TDEV (τ) = $31.623\tau^{0.5}$	$30 < \tau < 1000$
	Section D.2.2.1	TDEV (τ) = 100	$0.05 < \tau < 10$
		TDEV (τ) = $31.623\tau^{0.5}$	$10 < \tau < 1000$
	Section D.2.2.2	TDEV (τ) = 17	$0.05 < \tau < 3$
		TDEV (τ) = 5.77τ	$3 < \tau < 30$
		TDEV (τ) = $31.623\tau 0.5$	$30 < \tau < 1000$
ANSI T1.105.09-1996		TDEV (τ) = 10	$0.05 < \tau \leq 10$
		TDEV (τ) = $3.1623\tau^{0.5}$	$10 < \tau \leq 1000$
GR-2830-CORE-1995		TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau < 2.5$
		TDEV (τ) = 2	$2.5 < \tau < 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau < 10000$
GR-1244-CORE-1995	Section 4.3	TDEV (τ) = 100	$0.05 < \tau < 10$
		TDEV $31.6\tau^{0.5}$	$10 < \tau < 1000$
	Section 5.3	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau < 2.5$
		TDEV (τ) = 2	$2.5 < \tau < 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau < 1000$
		TDEV (τ) = 10	$1000 < \tau < 10000$
	Section 5.4 Stratum 2&3E	TDEV (τ) = 2	$0.05 < \tau < 1.1$
		TDEV (τ) = 1.82τ	$1.1 < \tau < 300$
		TDEV (τ) = $31.6\tau^{0.5}$	$300 < \tau < 1000$
	Section 5.4 Stratum 3	TDEV (τ) = 1000τ	$0.05 < \tau < 0.1$
		TDEV (τ) = 100	$0.1 < \tau < 10$
		TDEV (τ) = $31.6\tau^{0.5}$	$10 < \tau < 1000$
GR-253-CORE-1995	Section 5.4.4.2.4 Figure 5-15	TDEV (τ) = 10	$0.1 < \tau < 1.7$
		TDEV (τ) = 5.88τ	$1.7 < \tau < 30$
		TDEV (τ) = $31.62\tau^{0.5}$	$30 < \tau < 1000$
	Section 5.4.4.2.4 Figure 5-16	TDEV (τ) = 17	$0.1 < \tau < 3$
		TDEV (τ) = 5.67τ	$3 < \tau < 30$
		TDEV (τ) = $31.62\tau^{0.5}$	$30 < \tau < 1000$

Mask Name		Mask Formula	
GR-253-CORE-1995	Section 5.4.4.3.2	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau < 2.5$
		TDEV (τ) = 2	$2.5 < \tau < 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau < 1000$
		TDEV (τ) = 10	$1000 < \tau$
	Section 5.4.5	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau < 2.5$
		TDEV (τ) = 2	$2.5 < \tau$
ETS 300 462-3-1997	Section 7.2.1	TDEV (τ) = 3	$0.1 < \tau \leq 100$
		TDEV (τ) = 0.03τ	$100 < \tau \leq 1000$
		TDEV (τ) = $29.7 + 0.0003\tau$	$1000 < \tau \leq 1000000$
	Section 7.2.2	TDEV (τ) = 3	$0.1 < \tau \leq 4.3$
		TDEV (τ) = 0.7τ	$4.3 < \tau \leq 100$
		TDEV (τ) = $58 + 1.2\tau^{0.5} + 0.0003\tau$	$100 < \tau \leq 1000000$
	Section 7.2.3	TDEV (τ) = 12	$0.1 < \tau \leq 17.14$
		TDEV (τ) = $0.7t$	$17.14 < \tau \leq 100$
		TDEV (τ) = $58 + 1.2\tau^{0.5} + 0.0003\tau$	$100 < \tau \leq 1000000$
	Section 7.2.4	TDEV (τ) = 34	$0.1 < \tau \leq 48$
		TDEV (τ) = 0.7τ	$48 < \tau \leq 100$
		TDEV (τ) = $58 + 1.2\tau^{0.5} + 0.0003\tau$	$100 < \tau \leq 1000000$
ETS 300 462-4-1997	Section 6.1	TDEV (τ) = 3	$0.1 < \tau \leq 25$
		TDEV (τ) = 0.12τ	$25 < \tau \leq 100$
		TDEV (τ) = 12	$100 < \tau \leq 10000$
	Section 7.2	TDEV (τ) = 34	$0.1 < \tau \leq 20$
		TDEV (τ) = 1.7τ	$20 < \tau \leq 100$
		TDEV (τ) = 170	$100 < \tau \leq 1000$
		TDEV (τ) = $5.4\tau^{0.5}$	$1000 < \tau \leq 10000$
	Section 8	TDEV (τ) = 3	$0.1 < \tau \leq 13.3$
		TDEV (τ) = $0.017\tau^2$	$13.3 < \tau \leq 100$
		TDEV (τ) = 170	$100 < \tau \leq 1000$
		TDEV (τ) = $5.4\tau^{0.5}$	$1000 < \tau \leq 10000$
ETS 300 462-5-1996	Section 6.1	TDEV (τ) = 3.2	$0.1 < \tau \leq 25$
		TDEV (τ) = $0.64\tau^{0.5}$	$25 < \tau \leq 100$
		TDEV (τ) = 6.4	$100 < \tau \leq 1000$
	Section 7.2	TDEV (τ) = 12	$0.1 < \tau \leq 7$
		TDEV (τ) = 1.7τ	$7 < \tau \leq 100$
		TDEV (τ) = 170	$100 < t \leq 1000$
ETS 300 462-6-1997		TDEV (τ) = 3	$0.1 < t \leq 100$
		TDEV (τ) = 0.03τ	$100 < t \leq 1000$
		TDEV (τ) = 30	$1000 < t \leq 10000$

Mask Name		Mask Formula	
G.811-1997		TDEV (τ) = 3	$0.1 < \tau < 100$
		TDEV (τ) = 0.03τ	$100 < \tau < 1000$
		TDEV (τ) = 30	$1000 < \tau < 10000$
G.812-1997	Section 8.1 Table 6	TDEV (τ) = 3	$0.1 < \tau \leq 25$
		TDEV (τ) = 0.12τ	$25 < \tau \leq 100$
		TDEV (τ) = 12	$100 < \tau \leq 10000$
	Section 8.1 Table 7	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau \leq 2.5$
		TDEV (τ) = 2	$2.5 < \tau \leq 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau \leq 1000$
		TDEV (τ) = 10	$1000 < \tau$
	Section 9.1 Table 11	TDEV (τ) = 34	$0.1 < \tau \leq 20$
		TDEV (τ) = 1.7τ	$20 < \tau \leq 100$
		TDEV (τ) = 170	$100 < \tau \leq 1000$
		TDEV (τ) = $5.4\tau^{0.5}$	$1000 < \tau \leq 10000$
	Section 9.1 Table 12	TDEV (τ) = 100	$0.05 < \tau \leq 10$
		TDEV (t) = $31.6\tau^{0.5}$	$10 < \tau \leq 1000$
	Section 10 Table 18	TDEV (τ) = 3	$0.1 < \tau \leq 13.1$
		TDEV (τ) = $0.0176\tau^2$	$13.1 < \tau \leq 100$
		TDEV (τ) = 176	$100 < \tau \leq 1000$
		TDEV (τ) = $5.58\tau^{0.5}$	$1000 < \tau \leq 10000$
	Section 10 Table 19	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau < 1.44$
		TDEV (τ) = 1.86τ	$1.44 < \tau < 300$
		TDEV (τ) = $32.3\tau^{0.5}$	$300 < \tau < 1000$
	Section A.3.1	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau \leq 2.5$
		TDEV (τ) = 2	$2.5 < \tau \leq 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau \leq 1000$
		TDEV (τ) = 10	$1000 < \tau$
	Section A.4.1	TDEV (τ) = 100	$0.05 < \tau \leq 10$
		TDEV (τ) = $31.6\tau^{0.5}$	$10 < \tau \leq 1000$
	Section A.5	TDEV (τ) = 1020τ	$0.05 < \tau \leq 0.1$
		TDEV (τ) = 102	$0.1 < \tau \leq 10$
		TDEV (τ) = $32.2\tau^{0.5}$	$10 < \tau \leq 1000$
G.813-1996	Section 7.1 Option1	TDEV (τ) = 3.2	$0.1 < \tau \leq 25$
		TDEV (τ) = $0.64\tau^{0.5}$	$25 < \tau \leq 100$
		TDEV (τ) = 6.4	$100 < \tau < 1000$
	Section 7.1 Option2	TDEV (τ) = $3.2\tau^{-0.5}$	$0.1 < \tau \leq 2.5$
		TDEV (τ) = 2	$2.5 < \tau \leq 40$
		TDEV (τ) = $0.32\tau^{0.5}$	$40 < \tau \leq 1000$
		TDEV (t) = 10	$1000 < \tau \leq 10000$

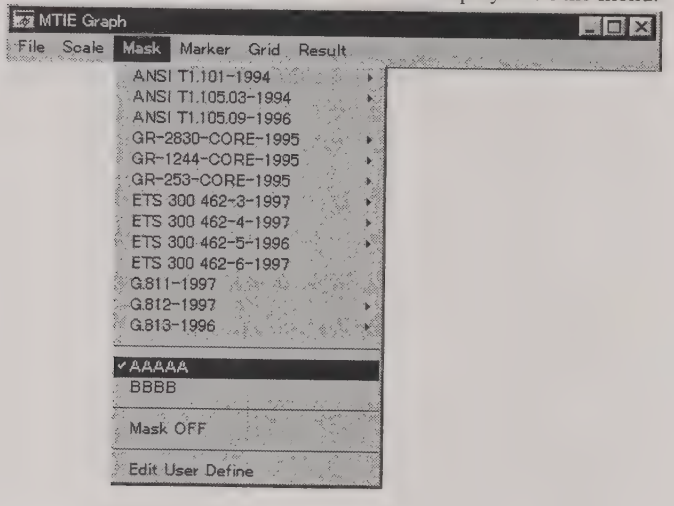
Wander Transfer (TDEV) graph and system-fixed mask

Mask Name		Mask Formula	
GR-1244-CORE-1995	Section 5.4 Stratum 2	TDEV (τ) = 2	$0.1 < \tau \leq 1.1$
		TDEV (τ) = 1.82τ	$1.1 < \tau \leq 300$
		TDEV (τ) = $3.16\tau^{0.5}$	$300 < \tau \leq 1000$
	Section 5.4 Stratum 3E	TDEV (τ) = 2	$0.1 < \tau \leq 1.1$
		TDEV (τ) = 1.82τ	$1.1 < \tau \leq 300$
		TDEV (τ) = $3.16\tau^{0.5}$	$300 < \tau \leq 1000$
	Section 5.4 Stratum 3	TDEV (τ) = 100	$0.1 < \tau \leq 10$
		TDEV (τ) = $3.16\tau^{0.5}$	$10 < \tau \leq 1000$

(2) Displaying user-defined mask

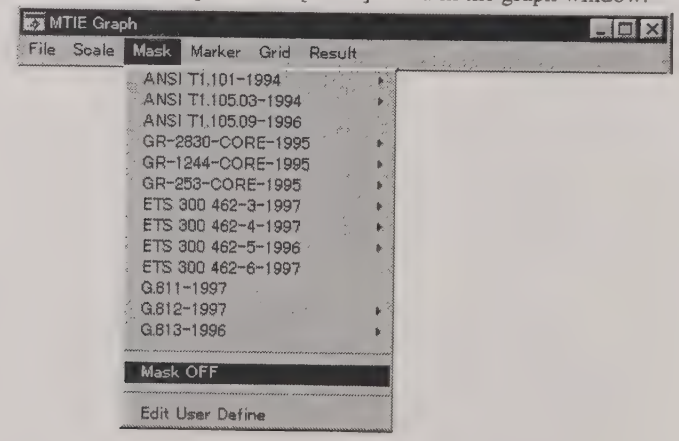
(a) Select [Mask] in the graph window. The following menu appears. When one or more user-defined masks are set, all masks currently set are displayed above the [Mask OFF] in the menu. Select a mask to be used. When a mask is selected, the mask line appears on the graph.

When no user-defined mask is set, it is not displayed on the menu.



(3) Deleting a mask line

(a) Select [Mask OFF] from the [Mask] menu in the graph window.



(b) The mask line displayed on the graph is deleted.

(4) Setting a user-defined mask

Arbitrary masks can be set. The set mask is retained after system termination. Up to 10 masks can be set for each graph. Four calculation formulae can be specified for a mask. Mask line is calculated and displayed based on the specified formula. The calculation formulae are as follows:

- Mask

  MTIE (τ) = Xns ○ < τ ≤ ○

  MTIE (τ) = Xns + (Yns/sec) ○ < τ ≤ ○

  Holdover Opt.01 (τ) = Xns

  Holdover Opt.01 (τ) = Xns + (Yns/sec) T^Z

  Holdover Opt.01 (τ) = Xns × Tsec + (Yns/2) × Tsec^2 + Zns*

  * Selectable only when Holdover Opt.01 is selected in the Test menu.

These procedures are explained below.

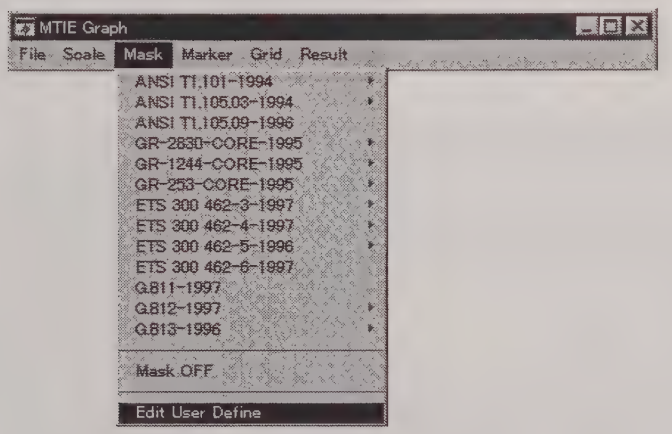
(4-1) Adding a user-defined mask

(4-2) Editing a user-defined mask

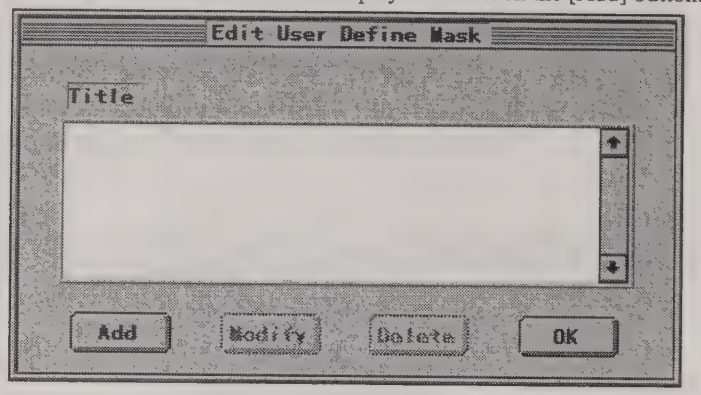
(4-3) Deleting a user-defined mask

(4-1) Adding a user-defined mask

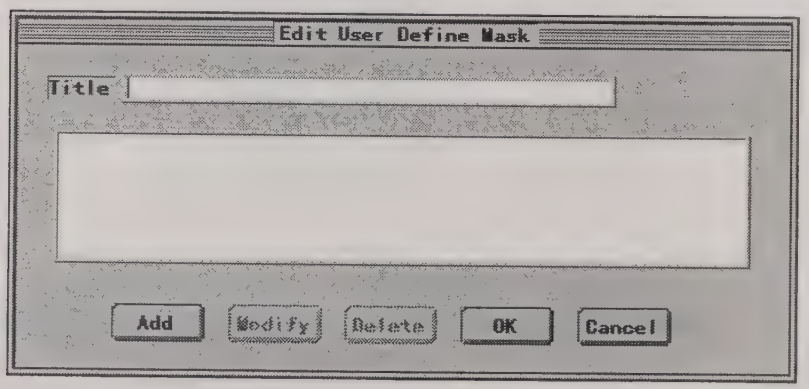
(1) Select [Edit User Define] from the [Mask] menu in the graph window.



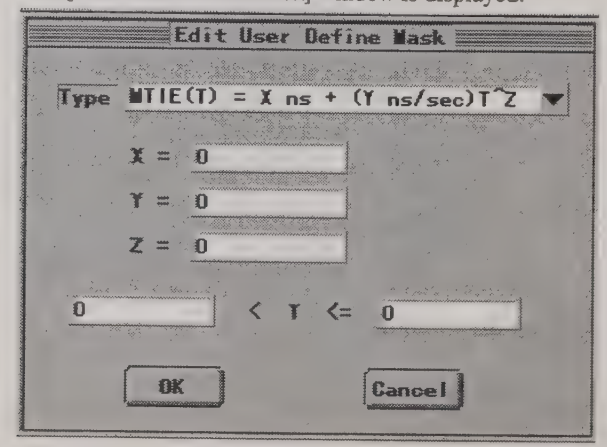
(2) A user-defined mask window is displayed. Click on the [Add] button.



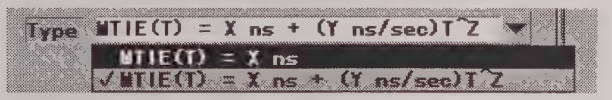
(3) The mask calculation formula selection window is displayed. Enter a title in the pane on the right of [Title]. After a title has been entered, click on the [Add] button.



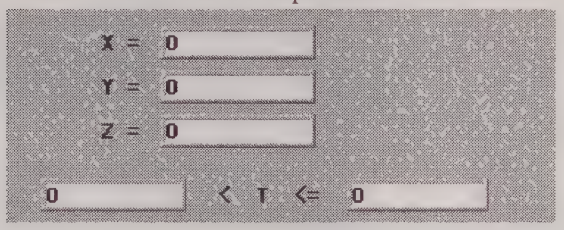
(4) The [Edit User Define Mask] window is displayed.



(5) Specify the mask calculation formula. When the bar located on the right of [Type] in the edit window shown above is clicked, the following menu appears and the formulae that can be set are shown. Select a calculation formula to use.

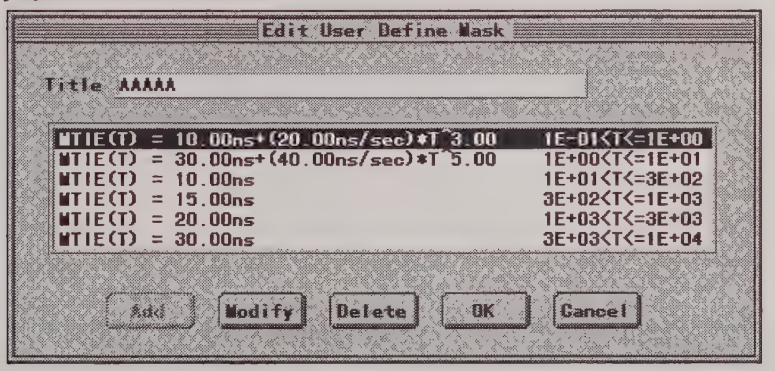


(6) Enter the coefficients (e.g., X, Y, Z, t) used in the calculation formula selected in step (5) above. Enter values in the coefficient input area in the middle of the edit window shown above to complete the calculation formula.



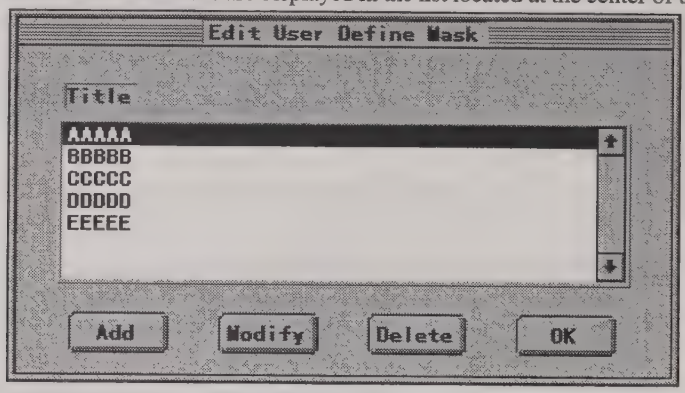
(7) When the calculation formula is completed and determined, click on the [OK] button of the edit window shown in step (4) above. The calculation formula is added to the mask and the [mask calculation formula selection] window appears. To cancel the calculation formula, click on the [Cancel] button in the edit window shown in step (4) above. All the input data is deleted, and the [mask calculation formula selection] window appears.

(8) To register another calculation formula, repeat steps from (3) to (7). Up to six calculation formulae can be registered. Registered calculation formulae are displayed in the list located at the center of the window.



(9) When all settings of calculation formula are completed, click on the [OK] button in the selection window shown in (8) above to add all calculation formulae to the mask. All the calculation formulae are added to the mask and the user-defined mask window is displayed. To cancel the setting of the calculation formula, click on the [Cancel] button in the selection window shown in (8). All the input data is deleted, and the user-defined mask window is displayed.

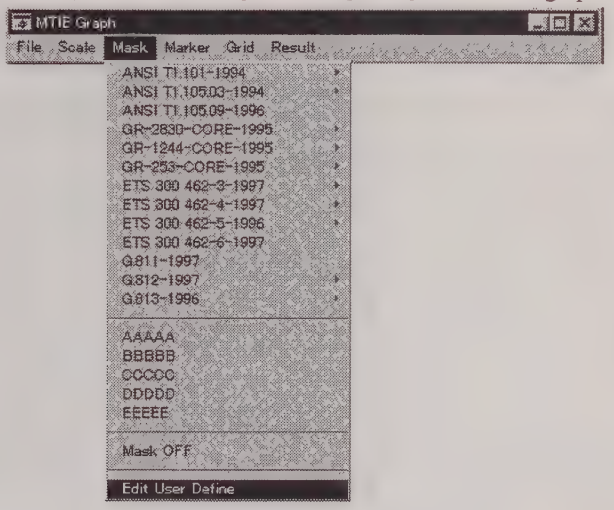
(10) To set another mask continuously, repeat steps (2) through (9). Up to 10 masks can be set. Set masks are displayed in the list located at the center of the window.



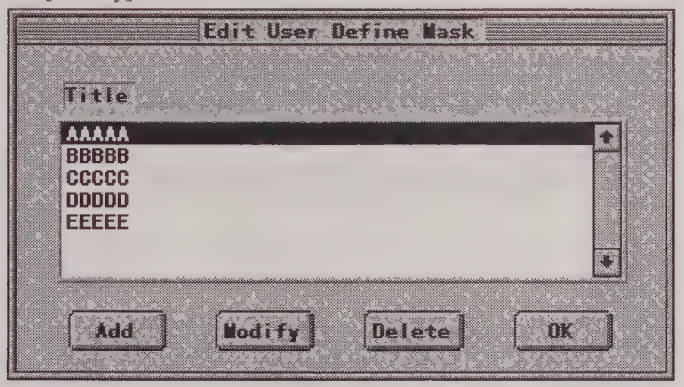
(11) When all the settings are completed, click on the [OK] button in the user-defined window shown in (10) above. The setting is applied to the system, and the graph window appears.

(4-2) Editing a user-defined mask

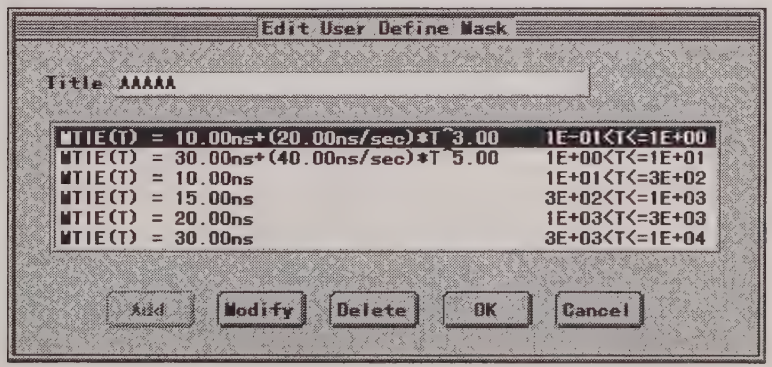
(1) Select [Edit User Define] from the [Mask] menu in the graph window.



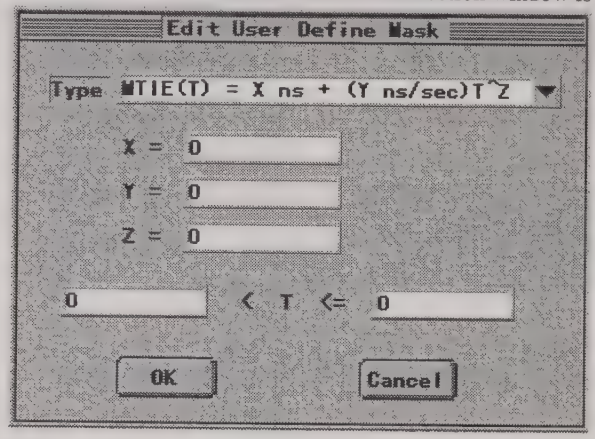
(2) The user-defined mask window appears. Select a mask to be edited, and click on the [Modify] button.



(3) The mask calculation formula selection window appears. To edit a calculation formula, select a calculation formula and click on the [Modify] button. To delete a calculation formula, select the calculation formula and click on the [Delete] button.



(4) If the [Modify] button is clicked in step (3), the following mask calculation formula edit window appears. Enter a new calculation formula, and click on the [OK] button. The calculation formula is updated and the mask calculation formula selection window appears. To cancel modification, click on the [Cancel] button. The mask calculation formula selection window is displayed.



(5) To edit another calculation formula continuously, repeat steps (3) and (4).

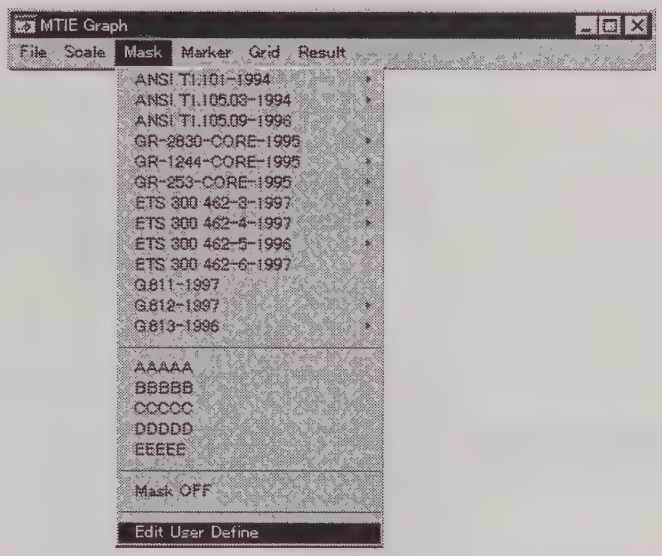
(6) When editing of the calculation formulae is completed, click on the [OK] button in the selection window shown in (3) above to update all calculation formulae. All the calculation formulae are updated and the user-defined mask window is displayed. To cancel the settings of calculation formula, click on the [Cancel] button of the selection window shown in (5). All the input data is deleted, and the user-defined mask window is displayed.

(7) To set another mask continuously, repeat steps (2) through (6).

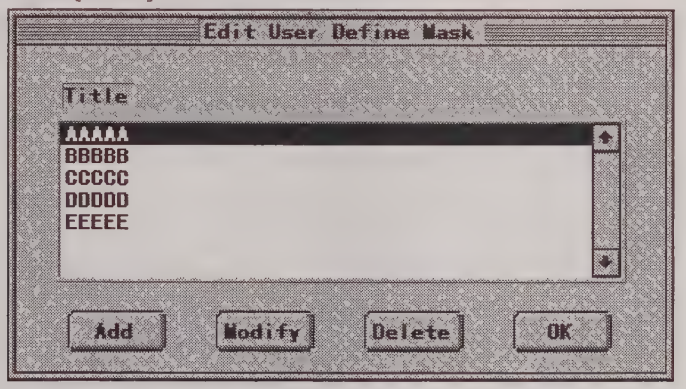
(8) When editing all masks is completed, click on the [OK] button in the user-defined window described in (2). The setting is applied to the system, and the graph window is displayed.

(4-3) Deleting a user-defined mask

(1) Select [Edit User Define] from the [Mask] menu in the graph window.



(2) The user-defined mask window appears. Select a mask to be deleted, and click on the [Delete] button. The selected mask is deleted.

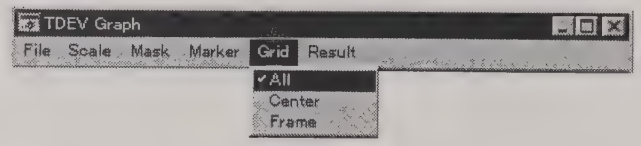


(3) When deletion is completed, click on the [OK] button in the user-defined window shown in (2) above. The setting is applied to the system, and the graph window is displayed.

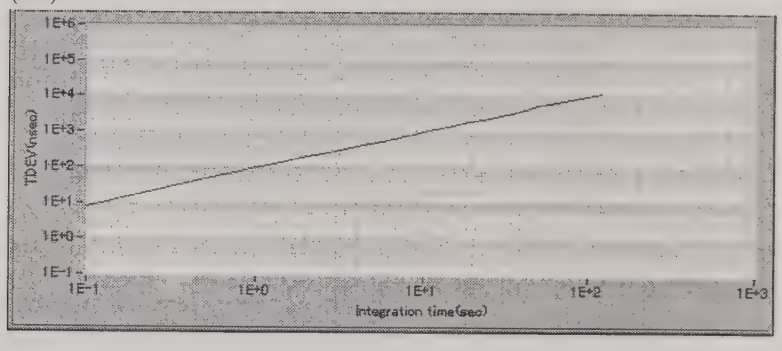
3.14.6 Changing the Grid

The grid displayed on the graph can be changed, as described below.
Operations are as follows:

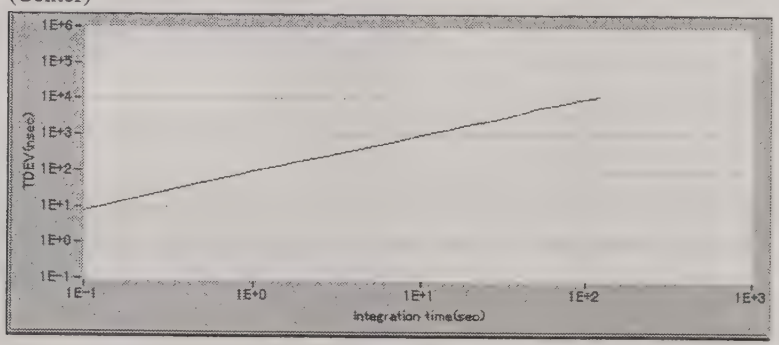
(1) Select [Grid] on the graph window. The following menu is displayed. Select [All], [Center], or [Frame] to display all the vertical/horizontal lines, only the vertical/horizontal center lines, or no vertical/horizontal lines, respectively.



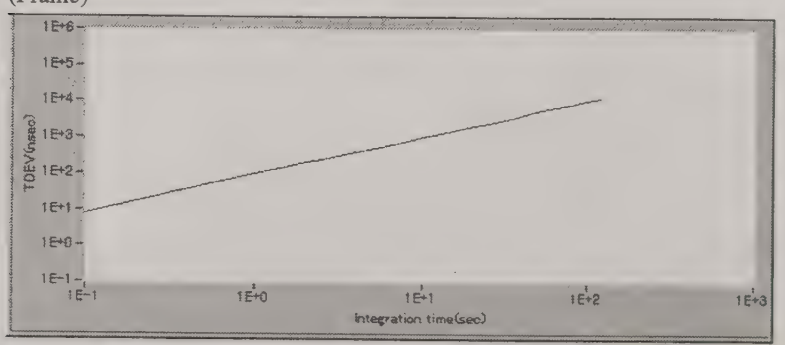
(All)



(Center)



(Frame)



3.14.7 Maker

A marker can be set on a graph. The maker location can also be displayed as a value. The marker can be moved on the graph using a mouse. Up to five markers can be set simultaneously for each graph.

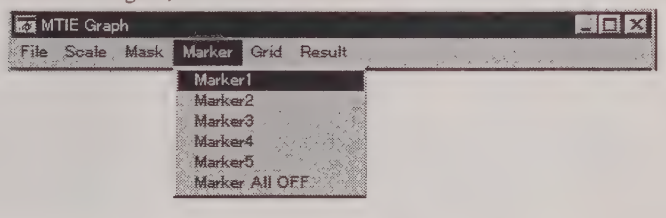
The following procedures are explained:

(1) Setting a marker

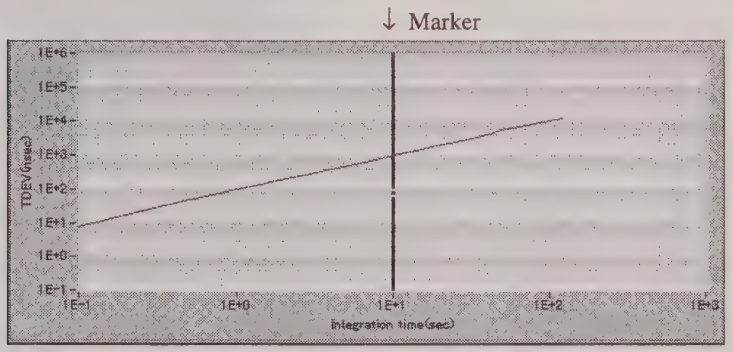
(2) Deleting a marker

(1) Setting a marker

(a) Select [Marker] on the graph window. The following menu appears. Select a marker from [Marker 1] through [Marker 5]. When a marker is selected, a check mark is indicated on top of the marker menu. When a checked marker is selected again, the marker is deleted.



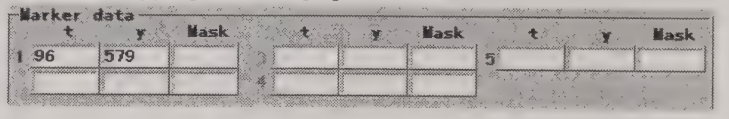
(b) A marker appears on the graph. When [Marker 1], [Marker 2], [Marker 3], [Marker 4], or [Marker 5] is selected; blue, yellow, pink, green, or red vertical line is displayed, respectively, on the graph.



(c) Move the marker as follows:

Move the mouse pointer onto the marker, and press the left mouse button. If the mouse is moved while holding the left mouse button, the marker also moves. Move the mouse until the marker is aligned to the desired location. When the marker is aligned to the desired location, release the left mouse button.

(d) The marker data values at the location are displayed in the [Marker Data] pane on the upper part on the graph window.



(2) Deleting a marker

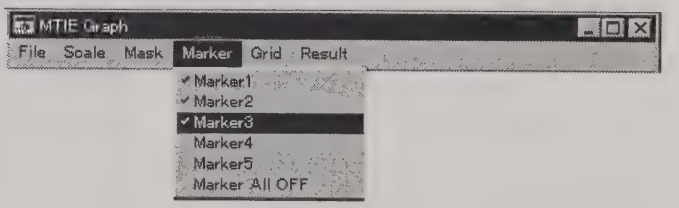
The following procedures are explained:

(a) Deleting markers individually

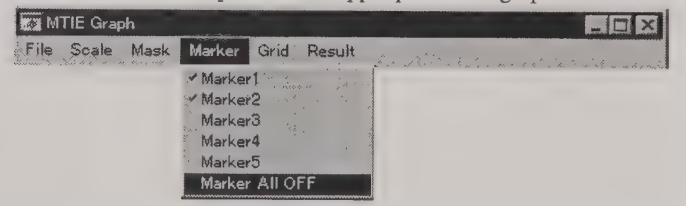
(b) Deleting all markers currently set at one time

(a) Deleting markers individually

(i) Select the [Marker] menu on the graph window. The following menu below appears. A check mark is indicated on the marker currently used. Select the marker with a check mark.



(ii) A vertical marker line displayed on the graph and the marker data displayed in the [Marker Data] pane on the upper part of the graph window are deleted.



(b) Deleting all markers currently set at one time

(i) Select [Marker All OFF] from the [Marker] menu on the graph window.

(ii) All vertical marker lines displayed on the graph and all marker data displayed in the [Marker Data] pane on the upper part of the graph window are deleted.

3.14.8 Scale and Zoom

Upper and lower limits of vertical and horizontal axes of the graph can be changed. Changing upper and lower limits of the axes can enlarge and reduce the graph size and range. Change in vertical axis is called the scale function, and that in horizontal axis called the zoom function.

The following operations are available:

(1) Auto scale
Automatically sets size and location of vertical axis to display a graph at an appropriate location.

(2) Full scale
Sets vertical and horizontal axes to a maximum scale. However, size of horizontal axis changes depending on the number of measurement data.

(3) Fixed scale
Fixes the scale at a value regardless of graph data. Size and location of vertical axis can be specified.

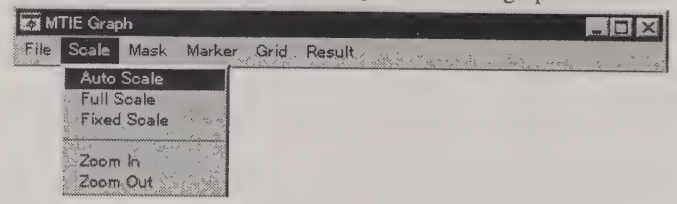
(4) Zoom-in
Enlarges horizontal axis scale centered at a marker location when the marker is set. When the marker is not set, horizontal axis scale is enlarged with the center at screen center point.

(5) Zoom-out
Reduces horizontal axis scale centered at a marker location when the marker is set. When the marker is not set, horizontal axis scale is reduced with the center at screen center point.

The following describes the operation procedures for the above five items.

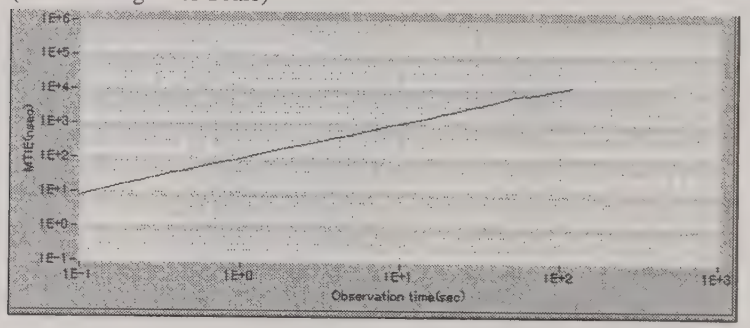
(1) Auto scale

(a) Select [Auto Scale] from the [Scale] menu on the graph window.

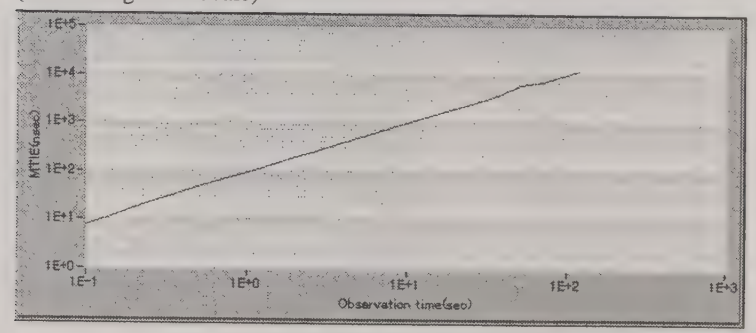


(b) The graph is changed so that it is displayed in an appropriate location.

(Before using Auto Scale)

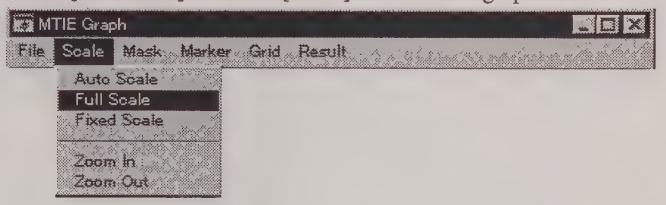


(After using Auto Scale)



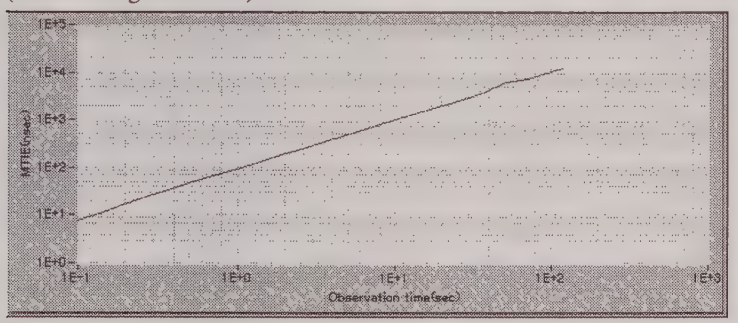
(2) Full scale

(a) Select [Full Scale] from the [Scale] menu on the graph window.

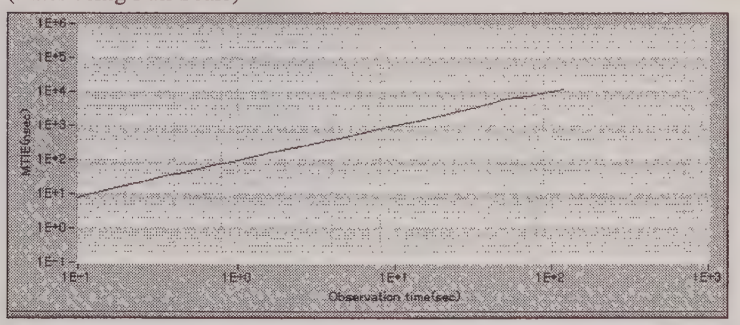


(b) The graph is changed so that it is displayed in a maximum scale.

(Before using Full Scale)

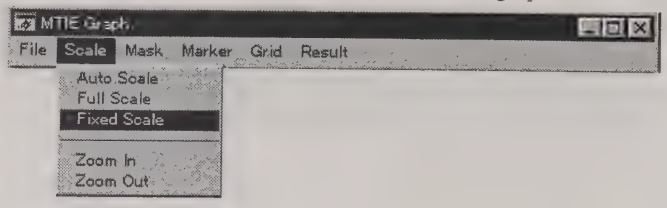


(After using Full Scale)

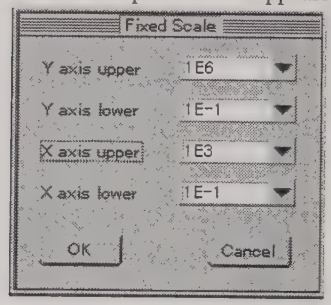


(3) Fixed scale

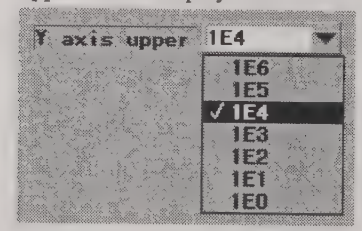
(a) Select [Fixed Scale] from the [Scale] menu on the graph window.



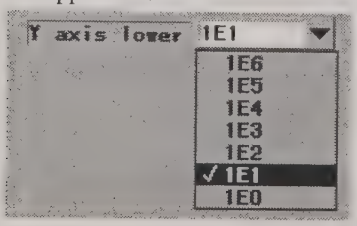
(b) The scale input window appears.



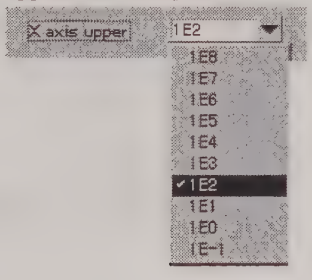
(c) Set the upper limit of the vertical axis. When the bar (located on the right of [Y Axis upper] of the scale input window) is clicked, a list of selectable upper limit is displayed. Select a value.



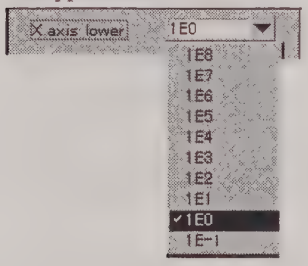
(d) Set the lower limit of the vertical axis. When the bar (located on the right of [Y Axis lower] of the scale input window) is clicked, a list of selectable lower limit is displayed. Select a value. Set the lower limit that is less than the upper limit.



(e) Set the upper limit of the horizontal axis. When the bar (located on the right of [X Axis upper] of the scale input window) is clicked, a list of selectable upper limit is displayed. Select a value.

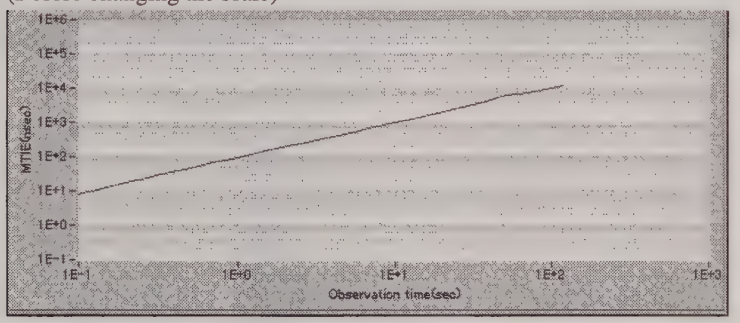


(f) Set the lower limit of the horizontal axis. When the bar (located on the right of [X Axis lower] of the scale input window) is clicked, a list of selectable lower limit is displayed. Select a value. Set the lower limit that is less than the upper limit.

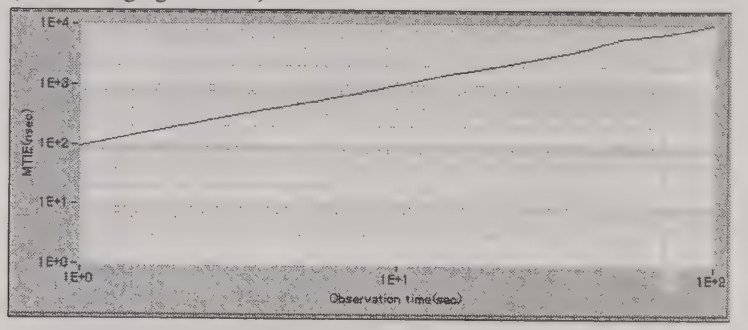


(g) When setting lower and upper limits is completed, click on the [OK] button to apply it to the graph. The graph window appears. The graph on the graph window is changed so that it is displayed in the specified scale. To cancel the settings of lower and upper limits, click on the [Cancel] button. All input data is deleted, and the graph window appears.

(Before changing the scale)

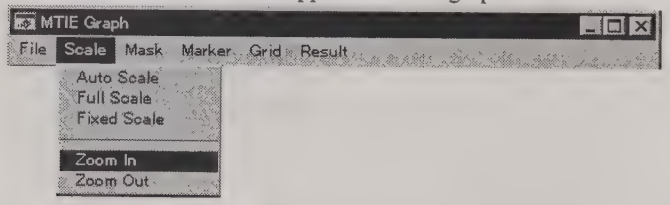


(After changing the scale)



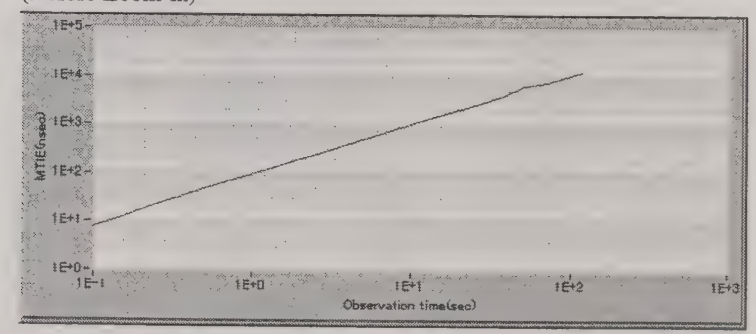
(4) Zoom-in

(a) Select [Zoom In] from the [Scale] menu on the graph window. Or, click on the [Zoom In] button on the upper left of the graph window.

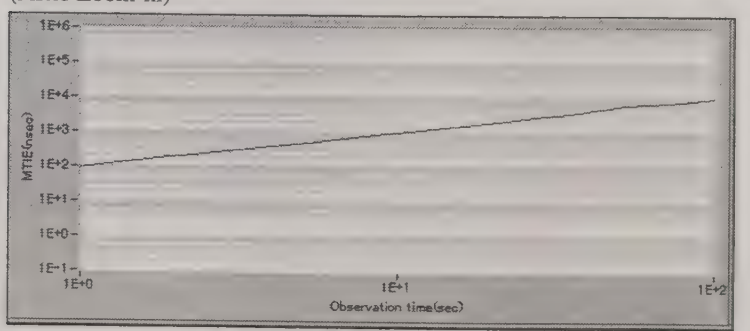


(b) The graph is changed with the horizontal scale enlarged.

(Before Zoom-in)

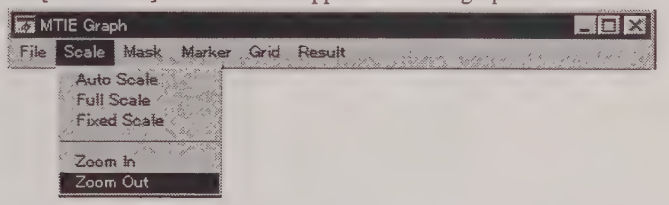


(After Zoom-in)



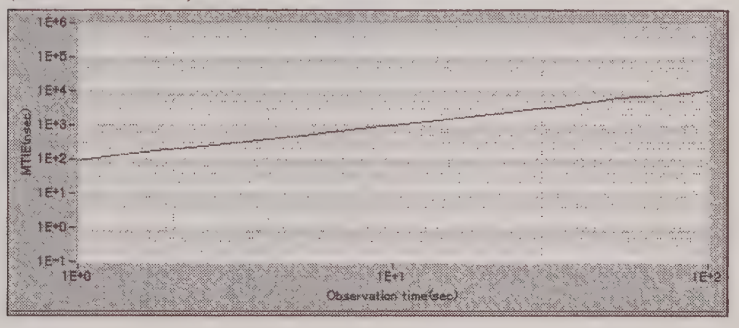
(5) Zoom-out

(a) Select [Zoom Out] from the [Scale] menu on the graph window. Or, click on the [Zoom Out] button on the upper left of the graph window.

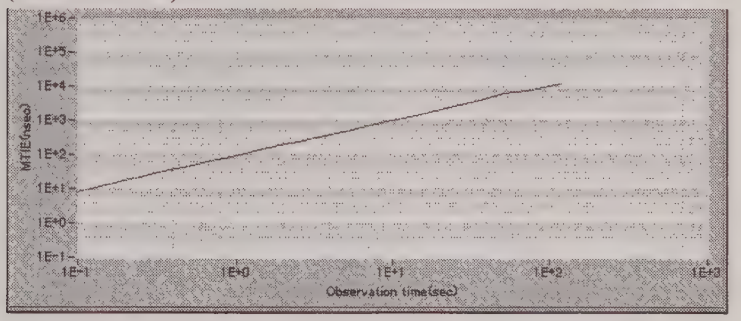


(b) The graph is changed with the horizontal scale reduced.

(Before Zoom-out)



(After Zoom-out)



3.14.9 Calculation Points

The following table shows calculation points to display TDEV and MTIE graphs:

Data No.	Observation Time				
	12 sec	120 sec	1200 sec	12000 sec	120000 sec
1	0.10	0.10	0.10	0.10	0.10
2	0.15	0.15	0.15	0.15	0.15
3	1.20	0.20	0.20	0.20	0.20
4	0.25	0.25	0.25	0.25	0.25
5	0.35	0.35	0.35	0.35	0.35
6	0.50	0.50	0.50	0.50	0.50
7	0.70	0.70	0.70	0.70	0.70
8	1.0	1.0	1.0	1.0	1.0
9	1.4	1.4	1.4	1.4	1.4
10	1.9	1.9	1.9	1.9	1.9
11	2.7	2.7	2.7	2.7	2.7
12	3.7	3.7	3.7	3.7	3.7
13	5.2	5.2	5.2	5.2	5.2
14	7.2	7.2	7.2	7.2	7.2
15	10	10	10	10	10
16	12	14	14	14	14
17		19	19	19	19
18		27	27	27	27
19		37	37	37	37
20		52	52	52	52
21		72	72	72	72
22		100	100	100	100
23		120	140	140	140
24			190	190	190
25			270	270	270
26			370	370	370
27			520	520	520
28			720	720	720
29			1.0E3	1.0E3	1.0E3
30			1.2E3	1.4E3	1.4E3
31				1.9E3	1.9E3
32				2.7E3	2.7E3
33				3.7E3	3.7E3
34				5.2E3	5.2E3
35				7.2E3	7.2E3
36				1.0E4	1.0E4
37				1.2E4	1.4E4
38					1.9E4
39					2.7E4
40					3.7E4
41					5.2E4
42					7.2E4
43					1.0E5
44					1.2E6

3.15 Print

Printing functions are as follows:

1) Prints measurement data using numerical values.
2) Prints measurement data using graph image.
3) Prints overall display image.
4) Changes printer.
5) Changes printer settings.

The following describes the above operation procedures.

3.15.1 Printing Measurement Data Using Numeric Values

Printing format for numerical data is dual configuration (i.e., measuring condition and measurement result).

Format of measurement result differs depending on the type of a graph. The printing format is shown in the following.

(1) Printing format for measuring condition

Title	: ABCDEFGHIJK				
Start time	: 21/Jan/100 18:04:56				
Bit rate	: 622M	Wander Ref. Output	: 2 MHz	Sampling Rate	: 40 Hz
Wander Ref. input	: 2 MHz (Unbalanced)	Maximum Phase	:	Freq. Drift Rate	:
Observation time	: 12 sec	TDEV Mask	:	Freq. Offset	:
Jitter/Wander Meas	: Data				

(a) Title
The contents of [Title] on the main window are printed.

(b) Start time
The contents of [Start time] on the main window are printed.

(c) Bit rate
Value of [Bit rate] of [Measuring condition] on the main window is printed.

(d) Wander Ref. input
Value of [Wander Ref. input] of [Measuring condition] on the main window is printed.

(e) Observation time
Value of [Observation time] of [Measuring condition] on the main window is printed.

(f) Jitter/Wander Meas

Contents of [Jitter/Wander measurement] of [Measuring condition] on the main window are printed.

(g) Wander Ref. Output

Contents of [Wonder Ref. Output] of [Measuring condition] on the main window are printed.

(h) Maximum Phase

Contents of [Maximum Phase deviation] of [Measuring condition] on the main window are printed.

(i) TDEV Mask

Symbols corresponding to the contents of [TDEV Mask] of [Measuring condition] on the main window are printed.

(j) Sampling Rate

Contents of [Sampling Rate] of [Measuring condition] on the main window are printed.

(k) Freq. Drift Rate

Value of [Freq. Drift Rate] of [Measuring condition] on the main window is printed.

(l) Freq. Offset

Contents of [Freq. Offset] of [Measuring condition] on the main window are printed.

(2) Printing format of measurement result

(2-1) TIE data

No.	Observ. time (sec)	TIE (nsec)	MRTIE (nsec)
1	0.10	0	---
2	0.15	0	---
:	:	:	:
n	n	n	---

(a) No.

Data number is printed.

(b) Observ. time (sec)

Values of Observation Time indicated by data number are printed.

(c) TIE (nsec)

TIE values indicated by data number are printed.

(d) MRTIE (nsec)

MRTIE values indicated by data number are printed.

(2-2) MTIE data

No.	Observ. time (sec)	MITE (nsec)	Judge
1	0.10	0	Pass
2	0.15	0	Pass
:	:	:	:
n	n	n	Pass

(a) No.

Data number is printed.

(b) Observ. time (sec)

Values of Observation Time indicated by data number are printed.

(c) MTIE (nsec)

MTIE values indicated by data number are printed.

(d) Judge

Pass or fail of the measurement results is decided for the Mask line previously specified.

(2-3) TDEV data

No.	Integration time (sec)	TDEV (nsec)	Judge
1	0.10	0	Pass
2	0.15	0	Pass
:	:	:	:
n	n	n	Pass

(a) No.
Data number is printed.

(b) Integration time (sec)
Values of Integration Time indicated by data number are printed.

(c) TDEV (nsec)
TDEV values indicated by data number are printed.

(d) Judge
Pass or fail of the measurement results is decided for the Mask line previously specified.

(2-4) Wander Tolerance (TDEV) data

No.	Integration time (sec)	Tolerance TDEV (nsec)	Judge
1	0.10	0	Pass
2	0.15	0	Pass
:	:	:	:
n	n	n	Pass

(a) No.
Data number is printed.

(b) Integration time (sec)
Values of Integration Time indicated by data number are printed.

(c) Tolerance TDEV (nsec)
TDEV values indicated by data number are printed.

(2-5) Wander Transfer (TDEV) data

No.	Integration time (sec)	Transfer (nsec)	Judge
1	0.10	0	Pass
2	0.15	0	Pass
:	:	:	:
n	n	n	Pass

(a) No.
Data number is printed.

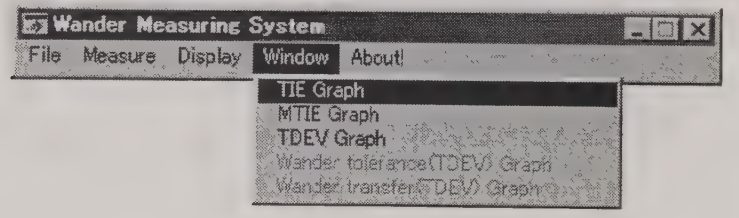
(b) Integration time (sec)
Values of Integration Time indicated by data number are printed.

(c) Transfer (nsec)
Transfer values indicated by data number are printed.

(d) Judge
Pass or fail of the measurement results is decided for the Mask line previously specified.

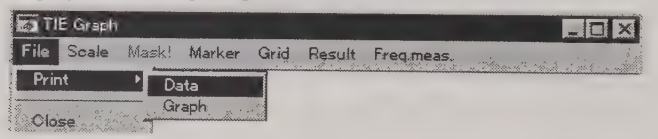
The following shows the printing procedures:

(1) Select [Display] menu in the main window. The following menu appears. Select a graph window of the measurement data to be printed.



(2) A graph window appears. Refer to subsection 3.14.1, [Outline of graph] for overview of the graph window.

(3) Select [Print] from the [File] menu on the graph window. The following menu is displayed. Select [Data].



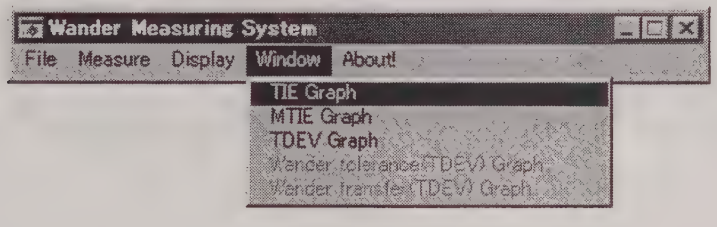
(4) Numerical data is output to the printer. A message indicating print condition may be displayed depending on the type of the operating system used.

(5) Since character size and line pitch differ depending on the type of printer, inadequate sized paper might be used for printing. If the paper size is not appropriate, adjust it by changing the print reduction rate of the printer. Refer to subsection 3.15.5, [Changing printer settings] for how to set the printer.

3.15.2 Printing Measurement Data Using Graph Image

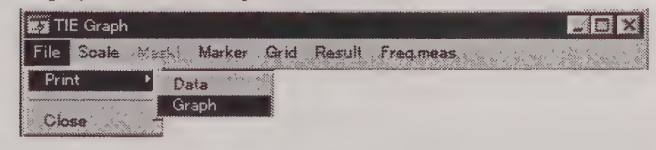
A specified graph image can be printed as it is.
The printing procedures are as follows:

(1) Select the [Display] menu of the main window. The following menu is displayed. Select a graph window of measurement data to be printed.



(2) A graph window is displayed. Refer to subsection 3.14.1, [Outline of graph] for overview of the graph window.

(3) Select [Print] from the [File] menu on the graph window. The following menu is displayed. Select [Graph].



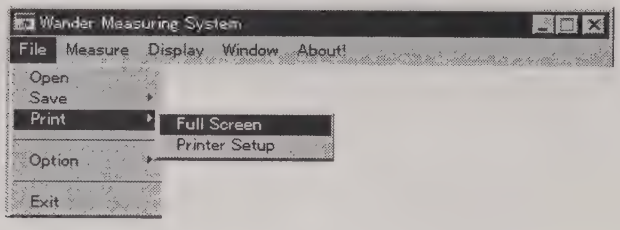
(4) A graph is output to the printer. A massage indicating print condition may be displayed depending on the type of the operating system used.

(5) Since character size and line pitch differ depending on the type of printer, inadequate sized paper might be used for printing. If the paper size is not appropriate, adjust it by changing the print reduction rate of the printer. Refer to subsection 3.15.5, [Changing printer settings] for how to set the printer.

3.15.3 Printing Overall Display Image

Overall display image can be printed.
The following shows the printing procedures:

(1) Select [Print] from the [File] menu on the graph window. The following menu is displayed. Select [Full Screen].



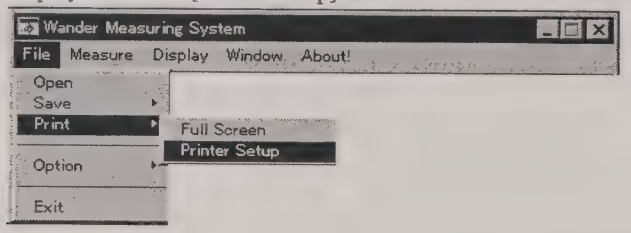
(2) A display image is output to the printer. A massage that indicates print condition may be displayed depending on the type of the operating system.

(3) Since character size and line pitch differ depending on the type of printer, inadequate sized paper might be used for printing. If the paper size is not appropriate, adjust it by changing the print reduction rate of the printer. Refer to subsection 3.15.5, [Changing printer settings] for how to set the printer.

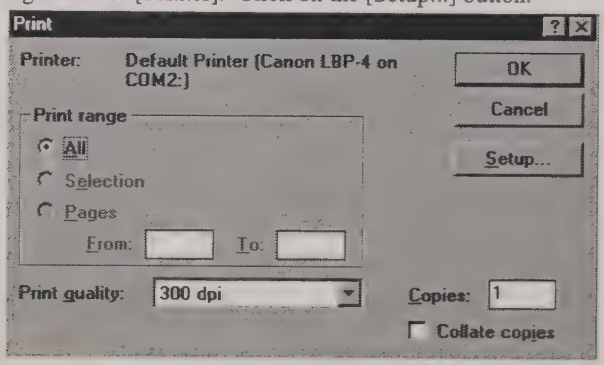
3.15.4 Changing Printer

Changing printer using Windows 95

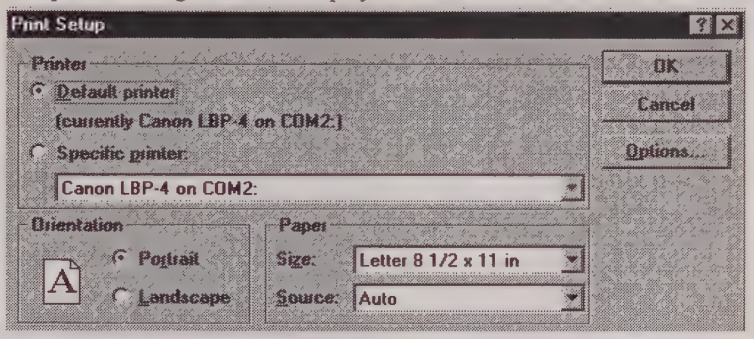
(1) Select [Print] from the [File] menu on the main window. The following menu is displayed. Select [Printer Setup].



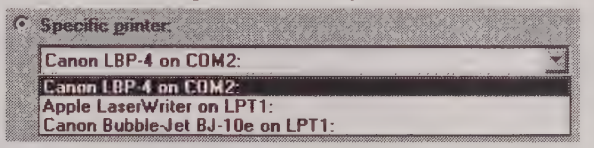
(2) The print window is displayed. The printer currently specified is displayed on the right side of [Printer]. Click on the [Setup...] button.



(3) The printer setting window is displayed.



(4) When the bar below [Specific Printer:] is clicked, the following menu appears. The menu lists the printers currently selectable. Select the desired printer.



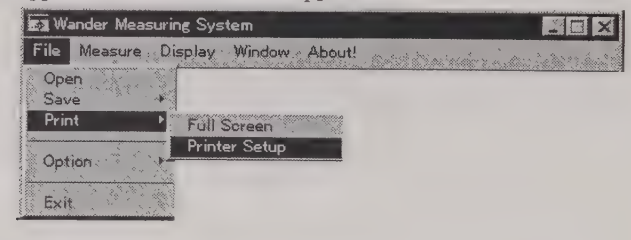
(5) When the printer has been selected, click on the OK] button in the printer setting window to determine. To cancel selection, click on the [Cancel] button. The print window appears.

(6) When the [OK] button was clicked in step (5) above, make sure that [Printer] in the print window has been changed to the printer selected in step (4). To determine the printer currently indicated, click on the [OK] button on the print window. The output printer is changed and the main window appears. To cancel the change of printer, click on the [Cancel] button on the print window. The main window appears without changing the output printer.

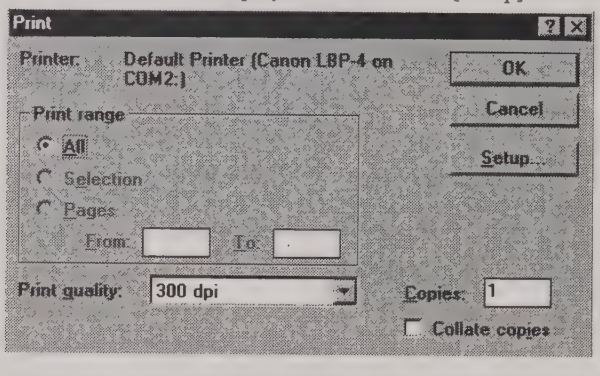
3.15.5 Changing Printer Settings

Changing printer settings using Windows 95

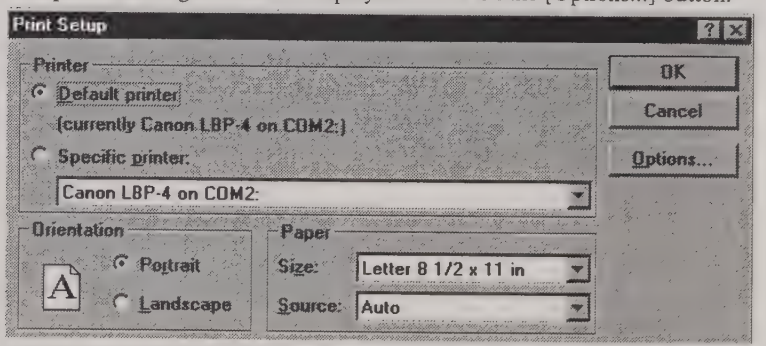
(1) Select [Print] from the [File] menu on the main window. The following menu appears. Select [Printer Setup].



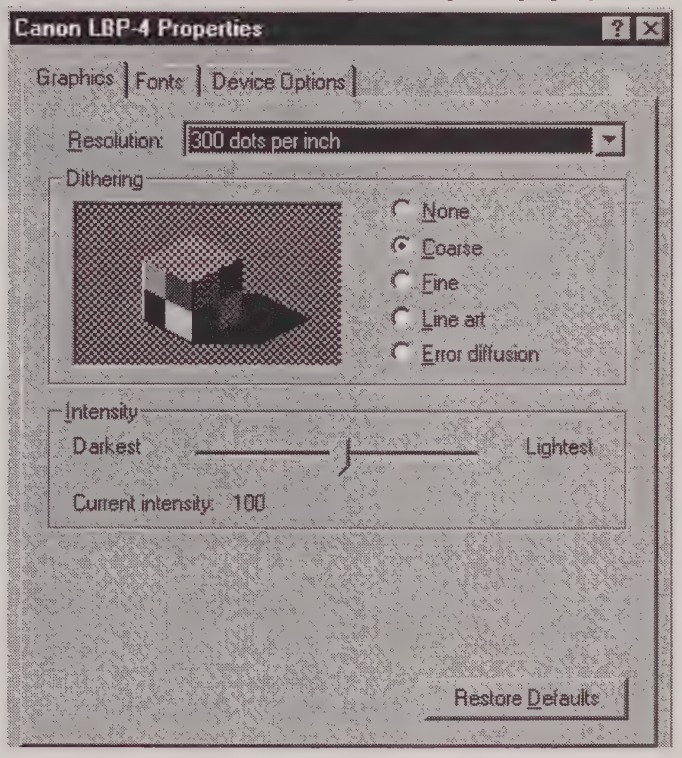
(2) The print window is displayed. Click on the [Setup] button.



(3) The printer setting window is displayed. Click on the [Options...] button.



(4) The printer property window is displayed. The printer property window differs depending on the type of printer driver. Refer to the operation manual that comes with the printer driver for how to operate the printer property window.



(5) When the printer has been set, click on the [OK] button on the printer property window to determine the printer settings. To cancel the settings, click on the [Cancel] button. The printer setting window appears.

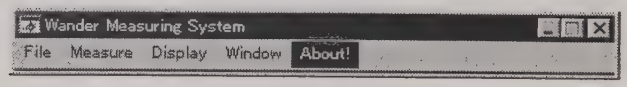
(6) To determine setting, click on the [OK] button on the printer setting window. To cancel, click on the [Cancel] button. The print window appears.

(7) To register the setting to the system, click on the [OK] button on the print window. The printer setting is changed and the main window appears. To cancel, click on the [Cancel] button on the print window. The main window is displayed without changing the setting.

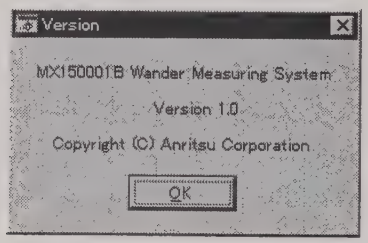
3.16 Version Information

The version of this software can be checked.
The procedure is as follows:

(1) Select [About!] on the main window.



(2) The following window appears. The information indicates that this system is version 1.0.



Click on the [OK] button to close the window.

Appendix A Definition of Jitter and Wander A-1

A.1 What is Jitter and Wander? A-2
A.2 Wander A-3
A.3 Wander Measurement A-3

Appendix B Wander Evaluation B-1

B.1 MTIE (Maximum Time Interval Error) Measurement B-2
B.2 TDEV (Time DEViation) Measurement B-3
B.3 Frequency Drift Rate Measurement B-4
B.4 Frequency Offset Measurement B-4

Appendix A Definition of Jitter and Wander

A.1 What is Jitter and Wander? A-2
A.2 Wander A-3
A.3 Wander Measurement A-3

A.1 What is Jitter and Wander?

In a digital network, a jitter or wander is a phenomena in which the timing of transmission signals is distorted due to noise on transmission lines or effects of transmission patterns, thus phases of each waveform fluctuate backward and forward from the average phase position (see Fig. A-1).

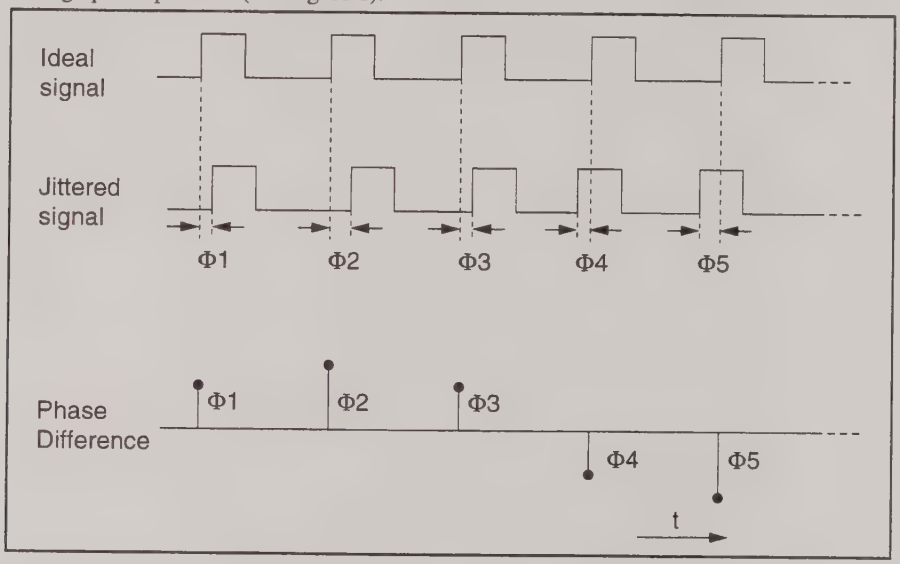


Fig. A-1

There is no definite boundary to classify a jitter or wander. However, 10 Hz fluctuation frequency (phase modulation frequency) of phase is a border. Frequency lower than 10 Hz is generally called a wander, and frequency higher than 10 Hz is called a wander (see Fig. A-2).

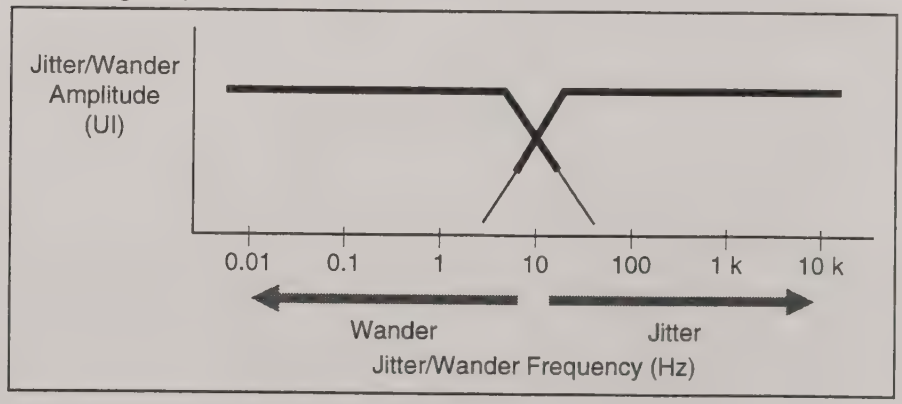


Fig. A-2

A.2 Wander

A wander is a slow phase fluctuation in which the fluctuation frequency (wander frequency) is DC to 10 Hz. Compared with a jitter, the wander requires wider measurement range (20 UIp-p or more). "nsec" is used as the measuring unit.

A.3 Wander Measurement

Fig. A-3 shows a configuration example of the wander measurement using the MP1570A. As shown in Fig. A-4, a phase between two signals (at start of measurement) is the reference value. TIE (Time Interval Error) indicates the phase difference compared with the phase at the start of measurement. +Peak and -Peak indicate the maximum positive phase variation and the maximum negative phase variation (compared with the phase at the start of measurement), respectively. Also, "peak to Peak" represents the amount of Peak-to-Peak variation of a measured signal against the reference signal.

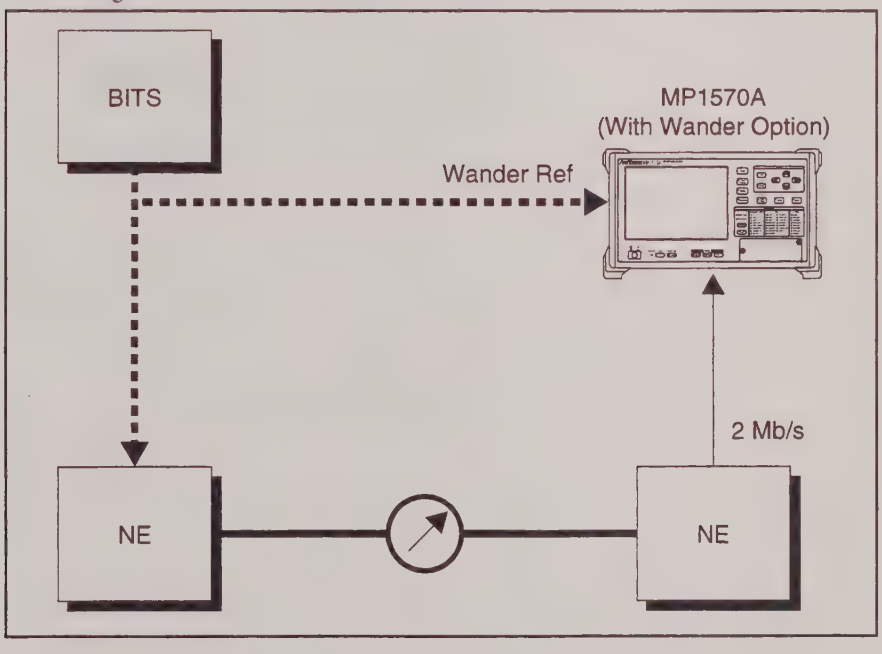


Fig.A-3

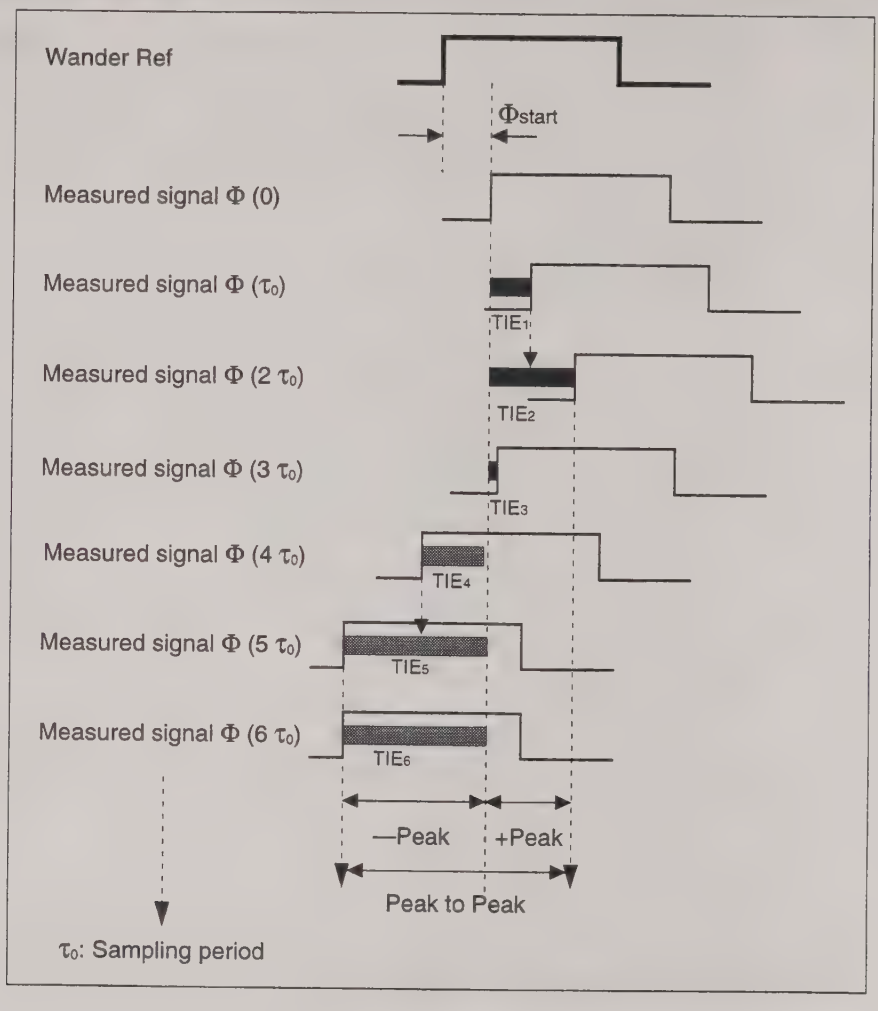

Wander Ref
Φstart
Measured signal Φ (0)
Measured signal Φ (τ0)
TIE1
Measured signal Φ (2 τ0)
TIE2
Measured signal Φ (3 τ0)
TIE3
Measured signal Φ (4 τ0)
TIE4
Measured signal Φ (5 τ0)
TIE5
Measured signal Φ (6 τ0)
TIE6
—Peak
+Peak
Peak to Peak
τ0: Sampling period

Fig.A-4

Appendix B Wander Evaluation

B.1 MTIE (Maximum Time Interval Error) Measurement .. B-2
B.2 TDEV (Time DEViation) Measurement B-3
B.3 Frequency Drift Rate Measurement B-4
B.4 Frequency Offset Measurement B-4

To measure phases with slow variation such as wander (DC to 10 Hz), the frequency stability can be used as the method. However, the MTIE and TDEV measurements that can be evaluated by using this system are suitable methods to standardize signals. These methods are standardized in ITU-T G.810 and G813.

B.1 MTIE (Maximum Time Interval Error) Measurement

MTIE measurement is done using TIE data based on formula (1). When the measuring result is represented by a graph, the horizontal axis is the Observation time ($\tau = n \cdot \tau_0$). (See Fig. B-1)

$$MTIE(\tau) \cong \max_{1 \le k \le N-n} \left(\max_{k \le i \le k+n} - \min_{k \le i \le k+n} \right) \quad \text{--- Formula (1)}$$

τ_0: Sampling period
τ: Observation time
T: Measurement period
n: Number of samples
N: Number of total samples

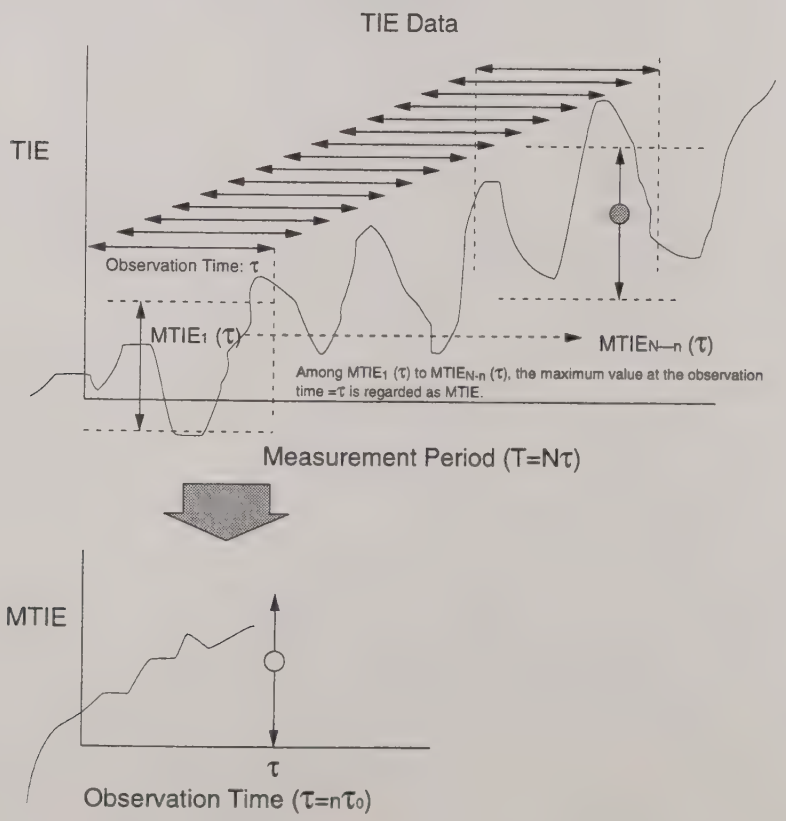


Fig. B-1

B.2 TDEV (Time DEViation) Measurement

TDEV measurement is done using TIE data based on formula (2). The TDEV measurement differs from that for MTIE. When the TDEV measurement result is to be represented by a graph, the horizontal axis indicates Integration time (t). TDEV is calculated based on all TIE data of measurement period (T) that is twelve times the maximum Integration time. For example of TDEV (1,000) with t = 1,000 seconds, measurement data of 12,000 seconds (80 samples/sec. x 1,000 sec. x 12 = 960,000 samples) is applied to formula (2). Then the result is calculated.

$$TDEV(\tau) = \sqrt{\frac{1}{6n^2}\,\frac{1}{(N-3n+1)}\sum_{j=1}^{N-3n+1}\left[\sum_{i=j}^{n+j-1}(\chi_{i+2n}-2\chi_{i+n}+\chi_i)\right]^2}$$ --- Formula (2)

χ_i: TIE sample data

N: Number of total samples

τ_0: Sample period ($\tau_0 = n \bullet \tau_0$)

n: Number of samples n = 1,2...N/3

B.3 Frequency Drift Rate Measurement

The frequency drift rate measurement calculates the frequency drift rate using the Formula (3) based on TIE data.

$$D_i = \frac{0.06}{N \bullet (\tau_0)^2} \bullet \sum_{i=1}^{N} \chi_i \bullet \left[\frac{6 \bullet i^2}{N^4 - 5N^2 + 4} - \frac{6 \bullet i}{N^3 - N^2 + 4N + 4} - \frac{1}{N^2 - 3N + 2} \right] \quad \text{--- Formula (3)}$$

D_i: Frequency drift rate
N: Number of samples
τ_0: Sampling period (s)
i = 0.....N: Sampling number
$N\tau_0$: Measurement time
χ_i : TIE (ns)

B.4 Frequency Offset Measurement

Frequency offset measurement calculates the frequency offset using the Formula (4) based on the TIE data.
Select [Freq. offset ON] on [Freq. meas.] menu at the TIE graph to display the Eliminated TIE (MRTIE) without frequency offset component of TIE data, simultaneously.

$$Y = \frac{0.06}{N\tau_0} \sum_{i=1}^{N} \chi_i \left[\frac{2i}{N^2 - 1} - \frac{1}{N - 1} \right] \quad \text{--- Formula (4)}$$

Y = Frequency offset
N: Number of samples
τ_0: Sampling period (s)
i = 0.....N: Sampling number
$N\tau_0$: Measurement time
χ_i : TIE (ns)

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